VOL. 44 APRIL 1917 NO. 4

APR 18 1917
UNIV. OF MICH. LIBRARY

BULLETIN OF THE TORREY BOTANICAL CLUB

Editor

ALEXANDER WILLIAM EVANS

Associate Editors

JEAN BROADHURST
JAMES ARTHUR HARRIS
MARSHALL AVERY HOWE
MICHAEL LEVINE
WILLIAM GEORGE MARQUETTE
ARLOW BURDETTE STOUT
NORMAN TAYLOR

CONTENTS

Contributions to the Mesozoic flora of the Atlantic coastal plain, XII.—Arkansas. (Plate 7.) . . . . . EDWARD W. BERRY 167

Notes on the genus Herberta, with a revision of the species known from Europe, Canada and the United States. (Plate 8.) ALEXANDER W. EVANS 191

INDEX TO AMERICAN BOTANICAL LITERATURE. 223

PUBLISHED FOR THE CLUB
THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President

HERBERT M. RICHARDS, Sc.D.

Vice-Presidents

JOHN HENDLEY BARNHART, A.M., M.D.
C. STUART GAGER, PH.D.

Secretary and Treasurer

BERNARD O. DODGE, PH.D.
Dept. of Botany, Columbia University
New York City

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, Dr. Bernard O. Dodge, Dept. of Botany, Columbia University, New York City.

Bulletin. Monthly, established 1870. Price, $4.00 a year; single numbers 40 cents. Of former volumes, only 24–43 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to the Editor, Osborn Botanical Laboratory, Yale University, New Haven, Connecticut. Papers should not exceed twenty pages in length, and illustrations (other than zinc etchings) should be limited to one page of half tones or one plate for each ten pages of text. Longer and more copiously illustrated papers, however, may be published if the excess pages and illustrations are paid for by the contributors.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Norman Taylor, Editor, Brooklyn Botanic Garden, Brooklyn, N. Y.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00

Reprints. Contributors of articles accepted for publication in the BULLETIN should order reprints, if desired, when they return galley proof to the editor. 25 copies of reprints without cover may be had gratis. If cover is wanted, or if more than 25 copies are wanted, they may be ordered through the editor at the following rates from The New Era Printing Co., Lancaster, Pa., contributor paying for all his reprints.

	2pp	4pp	8pp	12pp	16pp	20pp
25 copies	$ .75	$1.05	$1.30	$1.80	$2.20	$2.50
50 copies	.90	1.20	1.70	2.20	2.50	2.85
100 copies	1.15	1.55	1.95	2.55	2.90	3.20
200 copies	1.70	2.35	2.90	3.75	4.35	4.70

Covers: 25 for 75 cents, additional covers 1 cent each.
Plates for reprints, 40 cents each per 100.

Vol. 44 No. 4.

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Contributions to the Mesozoic flora of the Atlantic coastal plain, XII.—Arkansas*

EDWARD W. BERRY

(WITH PLATE 7)

The Upper Cretaceous of the Western Gulf area contains littoral sand beds of a magnitude great enough to be considered formational units. These are not restricted to a narrow horizon and the belief has been frequently expressed and is apparently probable that these sand formations are the time equivalents of several marine formations that are differentiated elsewhere in this area. The Woodbine sand of northeastern Texas is a case in point and another example is furnished by the Bingen sand of southwestern Arkansas. Both are without marine fossils so far as known and both contain fossil plants, those of the Woodbine sand having been reviewed by me† in 1912.

Recently Mr. H. D. Miser, of the United States Geological Survey, has sent me several small collections of fossil plants from the Bingen sand. These are, so far as I know, the first fossil plants collected from the Bingen sand. While the material is poor and not greatly varied, a number of species are determinable and these, while not as conclusive as might be wished, nevertheless shed considerable light on the correlation of the formation. Mr. Miser is to be congratulated for the care with which he has collected from such unpromising material.

The Bingen sand was named by Hill in 1888‡ from the town

[The BULLETIN for March (44: 117–166. *pl. 4–6*) was issued March 27, 1917.]

* The last previous contribution of this series appeared in the Bull. Torrey Club 43: 283–304. *pl. 16.* 1916.

† Berry, E. W. No. VIII of this series. Bull. Torrey Club 39: 387–406. *pl. 30–32.* 1912.

‡ Hill, R. T. Ann. Rept. Geol. Surv. Arkansas for 1888, 2: 56–58.

of Bingen in Hempstead County, Arkansas. It comprises near shore (littoral and estuarine) deposits of gravels and white to brown sands and clays with considerable lignitic material and occasionally fairly well preserved fossil plants. It outcrops in a nearly east and west direction commencing at the Ouachita River and showing isolated patches along the edge of the Paleozoic rocks in Clark County. Except where it is cut out by river bottoms it forms an almost continuous sheet across Pike, Hempstead, Howard and Sevier Counties. Veatch,* who mapped this area in 1902 and 1903, clearly recognized that while the Bingen sand of southwestern Arkansas was the lithologic counterpart of the Woodbine sand of northeastern Texas it was the chronological equivalent of not only more or less of the Woodbine but of a considerable portion of the overlying Upper Cretaceous, including at least all of the Eagle Ford formation of the Texas region and possibly the Austin and the earlier part of the Brownstown formation. Mr. Miser in his recent work in the Caddo Gap and De Queen quadrangles proposes to distinguish a lower and an overlapping upper Bingen, both of which have furnished fossil plants, although the collections from both are not far from the contact of the two and therefore well above the base of the Bingen in the one case and well below the top in the other.

The plants include twenty-seven determinable species for the most part identical with well-known Upper Cretaceous forms, and a fern pinnule that I have not ventured to name. The determined forms comprise one fern, four conifers, two cycadophytes (?), and twenty dicotyledons. The most abundant forms are *Sequoia concinna* and a new species of *Dewalquea*. Among the dicotyledons there are three species each of *Myrica* and *Ficus*, two each of *Salix*, *Liriodendron* and *Andromeda*, and one each of *Dewalquea*, *Menispermites*, *Colutea*, *Leguminosites*, *Manihotites*, *Cinnamomum*, *Sapindus* and *Cordia*. A list of the species with their outside distribution is shown in the accompanying table.

The largest collection (seventeen species) and the best preserved material comes from the Big Railroad Cut locality which is near the base of Mr. Miser's upper Bingen. Considering the Bingen flora as a whole it may be noted that it contains only one

* Veatch, A. C. U. S. Dept. Int. Geol. Surv. Professional Paper 46: 24. 1906.

species—the abundant *Dewalquea*—not known from other Upper Cretaceous formations of the Atlantic Coastal Plain. There are five species common to the little known flora of the Woodbine sand of northeastern Texas. Eighteen of the Bingen species occur in the Tuscaloosa formation of the Eastern Gulf area, six continue upward into the Eutaw formation and one is found as

	Big Railroad Cut near Maxwell Spur, Pike County	Adams' Kaolin Cuts near Murfreesboro, Pike County	Mine Creek near Nashville, Howard County	Woodbine	Tuscaloosa	Eutaw	Ripley	Black Creek	Dakota	Raritan	Magothy	Atane	Patoot	Colorado	Montana	Cenomanian	Turonian
Fern pinnule		×															
Dicksonia groenlandica		×	×		×					×		×	×				
Sequoia concinna	×				?					?	×		×			?	?
Sequoia heterophylla	×				×			×		×	×	×	×		×	×	
Widdringtonites subtilis	×				×			×		×	×	×					
Araucaria darlingtonensis	×				×			×									
Podozamites marginatus		×			×					×	×	×					
Podozamites sp.			×														
Myrica cliffwoodensis	×							×			×						
Myrica longa			×	×	×				×		×	×	×				×
Myrica cinnamomifolia			×							×							
Salix flexuosa	×	×	×		×	×		×	×	×	×						
Salix Lesquereuxii	×	×			×			×	×	×	×						
Ficus crassipes	×	×	×		×	×		×	×		×	×					
Ficus daphnogenoides	×			×	×			×	×	×	×						
Ficus ovatifolia (?)			×			×		×		×							
Dewalquea insignifolmis	×	×															
Liriodendron Meekii	×				×			×	×	×		×					
Liriodendron quercifolium			×	×						×							
Menispermites integrifolia	×				×												
Colutea primordialis	×			×					×	×	×	×					
Leguminosites omphalobioides	×				×				×		×						
Manihotites georgiana	×					×	×	×									
Sapindus Morrisoni	×		×	×				×	×		×	×	×				
Cinnamomum Newberryi (?)			×		×	×		×	×	×	×	×	×				
Andromeda novae-caesareae			×		×	×		×		×	×						
Andromeda Parlatorii			×		×			×	×	×	×	×					
Cordia apiculata	×				×					×	×						

high as the Ripley. Eleven species are common to the Dakota sandstone of the Western Interior and an identical number ranges northward far enough to be present in the Atane beds of western Greenland. Fifteen of the Bingen plants are recorded from the Black Creek formation of the Carolinas and there are seventeen common forms in both the Raritan and Magothy formations of

the northern Atlantic coastal plain. This serves to fix the age of the Bingen within the somewhat broad limits extending from the base of the Raritan to the base of the Ripley. The chief interest in the present contribution is, however, the somewhat more definite indications of age furnished by these collections.

The first two localities, namely the Big Railroad Cut and Adams Kaolin cuts in Pike County, are definitely located by Mr. Miser in the lower part of the upper Bingen and I shall consider these first. A total of nineteen species are determined. Of these three occur in the Woodbine and fourteen occur in the Tuscaloosa, eleven in the Raritan, thirteen in the Magothy, eleven in the Black Creek, three in the Eutaw and one in the Ripley. Among the upper Bingen plants are eight that are unknown as early as the Raritan. This fact and the presence of the *Manihotites*, which is a characteristic Eutaw and Ripley species, indicates that the upper Bingen is to be correlated with a part, presumably the upper, of the Woodbine, with the upper part of the Tuscaloosa and with the Eutaw formation of the Eastern Gulf area.

The correlation of the upper Bingen with the Eutaw confirms the suggestion of Veatch that it represents the interval during which the Eagle Ford formation was deposited throughout the Texas area, and as he and other students have suggested it may include the chronologic equivalent of still higher formations differentiated in Texas. This can only be determined paleobotanically by the discovery of more abundant materials from a number of horizons.

The locality in Howard County has furnished but twelve species, only four of which are found in the upper Bingen. It has not furnished any trace of the *Dewalquea* which is so common and characteristic a form in the upper Bingen nor are any of the four conifers of the latter represented. Forms like *Myrica cinnamomifolia* and *Liriodendron quercifolium*, peculiar to the Raritan, indicate that the lower Bingen is to be correlated with the Raritan, the lower Tuscaloosa and a part, presumably the lower, of the Woodbine.

The boundaries of all of the Upper Cretaceous formations of the Coastal Plain, determined as they have been by lithological differences instead of by their contained faunas or floras, overlap,

and the limits of the same formation are not chronologically coterminous when traced from locality to locality, so that final precision in correlation must wait for the discovery and study of abundant paleontological materials.

The species that have been determined from the Bingen sand are discussed in the following pages. This discussion is in most cases brief and only one or two important references to the literature are cited.

FILICALES

CYATHEACEAE

DICKSONIA Presl

DICKSONIA GROENLANDICA Heer

Dicksonia groenlandica Heer, Fl. Foss. Arct. 6²: 23. *pl. 35. f. 8, 9.* 1882.

Dicksonia borealis Heer, *Ibid. pl. 44. f. 2.*

Anemia stricta Newberry, Fl. Amboy Clays 38. *pl. 3. f. 1, 2.* 1896.

This characteristic species, which has a considerable vertical range in the Upper Cretaceous of the west coast of Greenland, is common in the middle Raritan of New Jersey and also occurs in the lower part of the Tuscaloosa formation of western Alabama. It is sparingly represented in both the lower and upper Bingen in Arkansas.

OCCURRENCE: Kaolin cuts in sec. 24 T8S. R24. W, Pike County; Mine Creek, three and one half miles north of Nashville, Howard County.

CYCADALES (?)

CYCADACEAE (?)

PODOZAMITES Fr. Braun

PODOZAMITES MARGINATUS Heer

Podozamites marginatus Heer, Fl. Foss. Arct. 6²: 43. *pl. 16. f. 10.* 1882.

This species was originally described from the Atane beds of western Greenland. It occurs in the Raritan formation of New Jersey and Maryland, in the Magothy formation of New Jersey,

and is very common in the lower part of the Tuscaloosa formation in western Alabama.

OCCURRENCE: Adams Kaolin cuts near Murfreesboro, Pike County.

PODOZAMITES sp.

Small fragments of a species of *Podozamites* occur in the collection from the east part of Section 2, but whether they represent *Podozamites marginatus*, which occurs elsewhere in the Bingen sand, as well as in the Tuscaloosa formation of the Eastern Gulf area, or some other of the numerous Cretaceous forms referred to this genus it is impossible to determine.

OCCURRENCE: Mine Creek, three and one half miles north of Nashville, Howard County.

CONIFERALES

PINACEAE

SEQUOIA Endlicher

SEQUOIA HETEROPHYLLA Velenovsky

Sequoia heterophylla Velenovsky, Gym. Böhm. Kreidef. 22. *pl. 12. f. 12; pl. 13. f. 2–4, 6–9.* 1885.

This characteristic species, described originally from the Cenomanian of Bohemia, may be readily recognized by the form of the foliage—the flat, lanceolate, decurrent leaves above, and the short and appressed leaves below. It has a wide geographical range as may be seen from the accompanying table of distribution. It has not yet been found but probably will be eventually discovered in the Woodbine sand, since it is not uncommon in the Tuscaloosa beds of western Alabama.

A considerable number of fragmentary but characteristic specimens have been collected from near the base of the upper part of the Bingen sand.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

SEQUOIA CONCINNA Heer

Sequoia concinna Heer, Fl. Foss. Arct. 7: 13. *pl. 49. f. 8b, c; pl. 50. f. 1b; pl. 51. f. 2–10; pl. 52. f. 1–3; pl. 53. f. 1b.* 1883; Berry, Geol. Surv. of New Jersey, Bull. 3: 96. 1911.

This species (FIGS. 1–5) was described by Heer from the Patoot beds of Greenland and has subsequently been recorded from the Raritan and Magothy formations of the United States and from the Emscherian of Italy. The foliage is distinguished with difficulty from that of *Sequoia fastigiata* (Sternberg) Heer, *Sequoia ambigua* Heer, and various other species. In the absence of well preserved cones it is doubtful if the species can be determined. Similar foliage from the Tuscaloosa formation of western Alabama I have referred to *Sequoia fastigiata*. The reference of the Bingen sand material to *S. concinna* rather than to the latter species is due to the presence of cones associated with the twigs in the latter formation.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

WIDDRINGTONITES Endlicher

WIDDRINGTONITES SUBTILIS Heer

Widdringtonites subtilis Heer, Fl. Foss. Arct. 3^2: 101. *pl. 28. f. 1b.* 1874. Berry, U. S. Dept. Int. Geol. Surv. Professional Paper 84: 25. *pl. 2. f. 14–17.* 1914.

This species was described from the Atane beds of Greenland by Heer in 1874. His material was, however, extremely limited. Subsequently it was found in considerable abundance in the Raritan formation of New Jersey, and still more recently Hollick recorded it from Marthas Vineyard and Block Island (Magothy formation). It may be questioned if some of the coniferous material described by Velenovsky from the Bohemian Cretaceous under other names should not be compared with the present form. It is even more slender than *Widdringtonites Reichii*, with much shorter twigs, which have the appearance of having been somewhat lax in habit. The leaves are usually more elongated, close set, and appressed, narrowly lanceolate, straight and scalelike; they are said by Heer to be somewhat spread and falcate proximad. Remains of this latter sort occur in the Tuscaloosa formation of Alabama where they bear characteristic valvate cones like those of the existing *Widdringtonia*.

This species has not yet been discovered in the Woodbine sand

of Texas but its remains are very abundant in the lower part of the upper member of the Bingen sand.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

ARAUCARIA Jussieu

ARAUCARIA DARLINGTONENSIS Berry

Araucaria darlingtonensis Berry, U. S. Dept. Int. Geol. Surv. Professional Paper 84: 20. *pl. 3. f. 1.* 1914.

Seed obovate in outline with broadly rounded apex, straight lateral margins, and somewhat narrowed rounded base, 1.25 cm. in length and 0.75 cm. in width across the widest part, 0.5 cm. wide at base.

This species was based on the seed of an araucarian conifer from the Middendorf member of the Black Creek formation of South Carolina where it was associated with the foliage of *Araucaria bladenensis* Berry. A single specimen is contained in the collection from the basal part of the upper member of the Bingen sand.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

MYRICALES

MYRICACEAE

MYRICA Linné

MYRICA CLIFFWOODENSIS Berry

Myrica cliffwoodensis Berry, Bull. Torrey Club **31**: 73. *pl. 4. f. 1.* 1904.

This species was based on small spherical fruits of the *Myrica* type from the Magothy formation of New Jersey which were subsequently found in the Black Creek formation of North Carolina. Similar fruits are extremely common in some of the pieces of clay from the basal part of the upper member of the Bingen sand.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

MYRICA CINNAMOMIFOLIA Newberry

Myrica cinnamomifolia Newberry, Fl. Amboy Clays 64. *pl. 22. f. 9–14.* 1896.

The finding of this species in the lower member of the Bingen sand is of considerable interest since it has heretofore been known only from the middle part of the Raritan formation in the New Jersey area where it is not uncommon. Its reference to the genus *Myrica* is questionable.

OCCURRENCE: Mine Creek, three and one half miles north of Nashville, Howard County.

MYRICA LONGA (Heer) Heer

Proteoides longus Heer, Fl. Foss. Arct. 3^2: 110. *pl. 29. f. 8b; pl. 31. f. 4, 5.* 1874.

Myrica longa Heer, *Ibid.* 6^2: 65. *pl. 18. f. 9b; pl. 29. f. 15–17; pl. 33. f. 10; pl. 41. f. 4d.* 1883.

Leaves of various sizes, linear to lanceolate in outline, with a stout midrib; numerous thin, ascending, camptodrome secondaries; entire margins, obtusely pointed apex; narrowly decurrent base and long stout petioles.

This species was described by Heer as a *Proteoides* and subsequently referred to the genus *Myrica*. It occurs in both the Atane and Patoot beds of Greenland, in the Dakota sandstones of the West, in the Magothy formation of Maryland, in the Woodbine formation of Texas, and is very common in the Tuscaloosa formation of Alabama. It is sparingly represented in the lower member of the Bingen sand. Abroad it has been recorded* from the lower Turonian of Bohemia.

OCCURRENCE: Mine Creek, three and one half miles north of Nashville, Howard County.

SALICALES

SALICACEAE

SALIX Linné

SALIX FLEXUOSA Newberry

Salix flexuosa Newberry, Later Ext. Floras 21. 1868.

Salix flexuosa Berry, U. S. Dept. Int. Geol. Surv. Professional Paper 84: 32, 109. *pl. 7. f. 14–16; pl. 11. f. 1.* 1914.

* Frič, Archiv. Naturw. Landes Böhm. 4: 18, 94. 1874.

Leaves narrow, linear-lanceolate in outline, equally pointed at both ends, short petioled, 5–10 cm. in length and 8–13 mm. in maximum width. Margins entire. Midrib stout below, tapering above, often somewhat flexuous. Secondaries more or less remote, about ten alternate pairs, branching from the midrib at angles varying from thirty-five to forty-five degrees, camptodrome, of fine caliber, often obsolete.

This species was described by Newberry from the Dakota sandstone. Lesquereux subsequently made it one of the varieties of his *Salix proteaefolia*, although it is obviously entitled to independent specific rank. It is of rare occurrence in the Raritan formation of New Jersey, and is preëminently a species which characterizes the Magothy formation from New Jersey to Maryland, and homotaxial horizons to the southward. It is recorded in beds of Magothy age from Marthas Vineyard to the Potomac River. It occurs in the Black Creek beds of North and South Carolina, and in the Middendorf member in the latter state. In Georgia, while not especially abundant, characteristic leaves of this species are found from the base to the top of the lower Eutaw formation in the western part of the state. In Alabama it is very common at a relatively large number of localities from the base to the top of the Tuscaloosa formation. It appears to be a common form in the Bingen sand occurring in both the lower and upper members.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur; Adams Kaolin cuts near Murfreesboro, Pike County; Mine Creek, three and one half miles north of Nashville, Howard County.

SALIX LESQUEREUXII Berry

Salix proteaefolia Lesquereux, Cret. Fl. 60. *pl. 5. f. 1–4.* 1874.
Salix Lesquereuxii Berry, Bull. Torrey Club **37**: 21. 1910.

Leaves ovate-lanceolate in outline, somewhat more acuminate above than below, variable in size, 6–12 cm. in length and 1.1–2.2 cm. in greatest width, which is usually slightly below the middle. Petiole stout, much larger than in *Salix flexuosa*, ranging up to 1.2 cm. in length. Midrib stout below, tapering above. Secondaries numerous, sometimes as many as twenty pairs; they branch from the midrib at angles of about forty-five degrees and are parallel and camptodrome.

This is an exceedingly variable species, and Lesquereux established several varieties of which at least one, *i. e.*, var. *linearifolia*, referable to *Salix flexuosa* Newberry. Some of Lesquereux's forms are distinguishable with difficulty from the latter. In general, *Salix Lesquereuxii* is a relatively much broader, more ovate form with more numerous and better seen secondaries and a longer petiole.

This species is an exceedingly abundant Upper Cretaceous type in both the East and the West, ranging in the Atlantic Coastal Plain from the base of the Raritan formation to the top of the Tuscaloosa formation, and possibly through the Eutaw formation as well. It is abundant in the Magothy, Black Creek, and Middendorf beds. In the West it is common in the Dakota sandstone. It is one of the forms recorded by Kurtz from the Upper Cretaceous of Argentina, indicating, if the identification is correct, a very considerable migration during the early Upper Cretaceous. In Alabama it ranges from the bottom to the top of the Tuscaloosa formation.

It has not yet been discovered in the Woodbine sand of Texas but appears to have been common in the upper member of the Bingen sand of Arkansas.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur; Adams Kaolin cuts near Murfreesboro, Pike County.

URTICALES

MORACEAE

FICUS Linné

FICUS DAPHNOGENOIDES (Heer) Berry

Proteoides daphnogenoides Heer, Phyll. Crét. d. Nebr. 17. *pl. 4.* 1866.

Ficus daphnogenoides Berry, Bull. Torrey Club **32**: 327. *pl. 21.* 1905.

This species has been found to be quite variable in size, ranging in length from 11 cm. to 22 cm. and in width from 1.9 cm. to 3.7 cm. It is usually widest in the lower half of the leaf, although sometimes the base is quite narrow and the widest part is toward the middle. In all unequivocal material the upper half of the leaf

is narrow and is produced as a long, slender, often recurved tip, which is one of the characteristic features of the species. This tip is strictly comparable with the "dripping points" developed on various leaves in the modern tropics where precipitation is heavy.

Ficus daphnogenoides is a widespread and common form ranging from Marthas Vineyard to Texas in eastern North America, and from Northwest Territory to Kansas and Nebraska in the Western Interior. It occurs in the Woodbine sand of northeastern Texas and in the Tuscaloosa formation of the Eastern Gulf area.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

FICUS CRASSIPES (Heer) Heer

Proteoides crassipes Heer, Fl. Foss. Arct. 3^2: 110. *pl. 31. f. 6–8a.* 1874.

Ficus crassipes Heer, *Ibid.* 6^2: 70. *pl. 17. f. 9a; pl. 24. f. 1, 2.* 1882.

Leaves entire, narrowly lanceolate in outline, about equally tapering to the acuminate apex and base. Length 12–20 cm. Greatest width, which is in the middle part of the leaf, 1.8–2.5 cm. Texture coriaceous. Midrib stout, often extraordinarily so. Secondaries thin, open, ascending, camptodrome.

This species was described originally from the Atane beds of western Greenland, the first rather fragmentary specimens collected suggested a relationship with the genus *Proteoides*. Subsequently the original describer referred it to *Ficus*, where it undoubtedly belongs. Lesquereux has recorded it from the Dakota sandstone and it is common in the Magothy formation of the northern Atlantic Coastal Plain, and in the Black Creek formation of North Carolina. It persists into the Eutaw formation of Georgia and is especially common in the Middendorf beds of South Carolina. It is not especially common in the Tuscaloosa formation, and is a species which is especially characteristic of the post-Raritan and pre-Montana horizons of eastern North America. It has not yet been discovered in the Woodbine sand of Texas but is present in both the lower and upper members of the Bingen sand of Arkansas.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur; Adams Kaolin cuts near Murfreesboro, Pike County;

Mine Creek, three and one half miles north of Nashville, Howard County.

FICUS OVATIFOLIA Berry (?)

Ficus ovata Newberry, Mon. U. S. Geol. Surv. **26**: 70. *pl. 24. f. 1–3.* 1896. Not Don, 1802–3.

Ficus ovatifolia Berry, Bull. Torrey Club **36**: 253. 1909.

Leaves ovate in outline, extended above into a narrow, usually pointed apex. Length 8–12 cm. Greatest width, which is in the basal part of the leaf, 4–7 cm. Base broadly rounded and in many specimens slightly decurrent. Margins entire. Primaries, three from the base, the midrib somewhat stouter than the lateral primaries. Secondaries camptodrome.

This species is closely allied to the Raritan species *Ficus Woolsoni* Newberry, differing primarily in its greater elongation and in the tendency of the former to a cordate outline. *Ficus ovatifolia* was described originally from the Raritan formation of New Jersey. It is present in the Black Creek formation of North Carolina and in the Eutaw formation in Georgia and Tennessee. The Bingen material is fragmentary and not certainly identified.

OCCURRENCE: Mine Creek, three and one half miles north of Nashville, Howard County.

RANALES

RANUNCULACEAE (?)

DEWALQUEA Saporta & Marion

Dewalquea insigniformis sp. nov.

Leaves digitate, of probably five leaflets. Leaflets linear-acuminate with prominently serrate margins. Length about 12 cm. Maximum width mostly 1–1.25 cm., at or slightly above the middle. Base very gradually narrowed and with entire margins for a distance of about 2 cm. Midrib stout, prominent on the under surface of the leaflets. Secondaries numerous, diverging from the midrib at angles of from thirty to forty degrees, long ascending and eventually camptodrome, sending off small outwardly directed branches to the marginal teeth. Texture coriaceous. [FIGS. 6, 7.]

This characteristic new species with its coriaceous texture must have had rather stiff strict leaves in life. It adds to our flora

another form of the curious genus *Dewalquea* that is such a striking element in the Upper Cretaceous and Lower Eocene. The only known American species that resembles this new form in any respect is *Dewalquea Smithi* Berry* of the Tuscaloosa and Black Creek formations. The latter is much larger with relatively broader leaflets which have less prominently serrate margins and partially craspedodrome venation.

Dewalquea insigniformis is, however, as its name indicates, very much like *Dewalquea insignis* Hosius and V. d. Marck,† a prominent species in the Campanian and Maestrichtian substages of Europe. The latter has relatively broader, less prominently toothed leaflets, sometimes as many as seven in number, and the venation is said to be craspedodrome. The latter is, however, a character of slight value since entire and toothed leaflets generally occur together and I imagine that *Dewalquea insignis* is merely a serrate form of the associated *Dewalquea haldemiana* Saporta and Marion. If the latter had prominent serrate teeth added it would be identical with *Dewalquea insigniformis*.

The latter is represented by a large number of fragmentary specimens from the upper member of the Bingen sand the most perfect of which is shown in solid black in the accompanying figure.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur; Adams Kaolin cuts near Murfreesboro, Pike County.

MAGNOLIACEAE

LIRIODENDRON Linné

LIRIODENDRON MEEKII Heer

Liriodendron Meekii Heer; Meek & Hayden, Proc. Phila. Acad. Sci. **10**: 265. 1858; Phyll. Crét. d. Nebr. 21. *pl. 4. f. 3, 4.* 1866.

Leaves of relatively small size, more or less panduriform in outline (described by Newberry as three-lobed with the median lobe emarginate). Length along the midrib 5–10 cm., usually about 5 cm., the Alabama specimen being 4.7 cm. Greatest width, which is toward the base of the leaf, 2.4–7 cm., averaging

* Berry, E. W. Torreya **10**: 34–38. *f. 1.* 1910.

† Hosius & V. d. Marck. Palaeontographica **26**: 172. *pl. 32. f. 111–113; pl. 33 f. 109; pl. 34. f. 110; pl. 35. f. 123.* 1880.

about 4 cm., the Alabama specimen being 4.3 cm. Lobes more or less well marked, the basal pair directed laterally, and broadly rounded, the upper pair directed diagonally, usually less well marked, rounded at the outside and inclined toward angularity at the tip. Lateral sinuses more or less indented in the typical forms, such as the Alabama specimen figured, extending nearly half way to the midrib and broadly rounded. Apical sinus wide and open, usually cuneate in outline. Base somewhat descending close to the midrib, broadly and somewhat curved-cuneate. Midrib stout, straight, or somewhat curved. Secondaries thin, parallel, about six pairs branching from the midrib at angles of over 45 degrees and gently curving upward toward their extremities, probably camptodrome, their ultimate course not made out.

The mid-Cretaceous leaves, variously described as *Liriodendron Meekii*, *L. primaevum*, *L. semialatum*, and *L. simplex*, are in a state of almost hopeless confusion, due largely to the difficulty of determining the specific lines of cleavage in a probably genetic and variable series of forms.

Liriodendron Meekii was described by Professor Heer in 1858, from the Dakota sandstone of Nebraska, in an appendix to a paper by Meek and Hayden. It was described as trilobate and was figured, but was compared with the European *Liriodendron Procacinii* Unger and with the living *Liriodendron Tulipifera* Linné. In 1866 the same author returns to this subject, figuring the two well-known specimens, which figures have been reproduced by both Lesquereux and Newberry. It would seem that this form must be considered as the type of this species and the present writer so considers it. However, Heer, in describing the Atane flora of Greenland in 1882, in returning to this subject, considers this form, as well as various simple emarginate *Liriodendropsis*-like forms, as different varieties of *Liriodendron Meekii*, and in this he was subsequently followed by Lesquereux, but not by Newberry, who insisted upon the distinctness of the lobate form. We find one of these varieties of Heer's *Liriodendron Meekii genuina* which may belong here, although the leaves are exceptionally large and poorly preserved. Another variety, *Liriodendron Meekii primaeva*, includes the slightly lobate forms subsequently referred to *Liriodendron primaevum* Newberry. It would seem that the small entire retuse leaves which have been variously referred to *Leguminosites*, *Bumelia*, *Bignonia*, *Liriodendron Meekii*,

and *L. primaevum*, as well as to *Liriodendron simplex* and to the genus *Liriodendropsis*, are more probably allied to the Leguminoseae than to *Liriodendron*, and they are so considered in the present study. On the other hand, *Liriodendron Meekii* is restricted to include only such lobate forms as do not seem to be specifically distinct from the originally figured types, and with them are merged those forms usually referred to *Liriodendron primaevum* Newberry, which are simply variants of the type just mentioned with less prominently developed lobes.

As here delimited the species is found in the Dakota sandstone, in the Raritan formation, or possibly the Magothy formation (morainic material) on Staten Island, somewhat doubtfully in the Atane beds of Greenland, doubtfully in the lower part of the Black Creek formation of North Carolina,* positively in the lower part of the Alabama Tuscaloosa, and doubtfully in the South American Cretaceous and in the Cenomanian of Saxony.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

LIRIODENDRON QUERCIFOLIUM Newberry

Liriodendron quercifolium Newberry, Bull. Torrey Club **14**: 6. *pl. 62. f. 1.* 1887; Fl. Amboy Clays, 81. *pl. 51. f. 1–6.* 1896.

Leaves oblong in general outline, of large size, pinnately divided by narrow sinuses into from two to four lateral lobes. Apex emarginate. Base truncate to somewhat cordate. Length along the midrib 7–9 cm. and probably considerably greater in some specimens since one fragment measures 12 cm. in width. Width in perfect specimens about 9 cm. Lateral lobes ovate in outline with very acute tips, sometimes narrowed proximad giving them an almost obovate outline; intervening lateral sinuses narrow and deeply cut, in some instances reaching nearly to the midrib, rounded.

In some specimens only two main lobes are developed on each side, which are then quite similar to the typical modern leaf. In these cases, however, the upper lobes are divided by a shallow sinus into two sharp lobules. Other specimens show three lobes of equal magnitude on each side, while one of the best specimens has four nearly equal lobes on each side, the basal and

* Berry, Bull. Torrey Club **34**: 197. 1907.

apical pairs being somewhat shorter than the medial pairs. This form of leaf is very suggestive of some species of *Quercus*, but its variations, as well as its venation, show that it is related to *Liriodendron*. The petiole is preserved for a considerable length and is very stout, as is the midrib. There is one main secondary traversing each lobe and running directly to its apical point. In addition there are one or more camptodrome secondaries in each lobe which anastomose with branches from the main secondary, their number being dependent upon the relative width of the lobe; they branch from the midrib at angles of about sixty degrees.

At first sight this species appears to differ considerably from *Liriodendron oblongifolium* and from the modern form, but this difference is not nearly as great as it seems, and it is probable that *Liriodendron quercifolium* is simply a variation from the common ancestor of the two species in the direction of *Liriodendron pinnatifidum* Lesq. Numerous leaves of the modern tree can be found with an incipient lobation suggesting *Liriodendron quercifolium*. In these, however, the sinus is comparatively shallow and rounded, so that the general appearance of the two is not markedly similar.

OCCURRENCE: Mine Creek, three and one half miles north of Nashville, Howard County.

MENISPERMACEAE

MENISPERMITES Lesquereux

Menispermites integrifolia sp. nov.

Leaves deltoid-ovate in outline, with a short sharply pointed apex and a truncate or slightly cordate peltate base. Length about 6.5 cm. Maximum width, in the basal part of the leaf, about 6.5 cm. Margins entire, full and rounded. Texture subcoriaceous. Petiole missing. Midrib stout, enlarges proximad. Lateral primaries subopposite, suprabasilar, but slightly differentiated from true secondaries, of which they constitute the second pair: they diverge from the midrib at angles of about forty-five degrees or slightly more, are relatively straight for more than half of the distance to the margin where they curve upward and are eventually camptodrome. Secondaries well marked, four or five opposite to alternate pairs, irregularly spaced, one pair below the primaries, camptodrome. Primaries give off on their outer sides, three to

five curved camptodrome laterals. Tertiaries thin percurrent with occasional laterals from midrib parallel with secondaries.

The present species is not at all trilobate as are some of the Dakota sandstone species, from which it also differs in having camptodrome instead of craspedodrome lateral primaries. Among described forms it is like some of the New Jersey Raritan leaves that Newberry referred to *Menispermites borealis* Heer, without greatly resembling the type material of the latter species. The most similar figured form is Newberry's *pl. 50. fig. 2*, Fl. Amboy Clays, which differs from the present species in its inequilateral form. Superficially *Menispermites integrifolia* suggests the associated *Cordia apiculata* (Hollick) Berry, differing especially in its peltate base. It may be also compared with various Upper Cretaceous leaves commonly referred to *Populus*, some of which have been referred by various students to *Cocculus*. The latter genus seems to be the closest to the fossil but in view of the uncertainty of such a reference *Menispermites* will serve equally well as a generic designation for leaves of the family Menispermaceae.

The present species is represented by incomplete specimens in the upper member of the Bingen sand which it is inadvisable to figure. The foregoing description is based on the complete type material from the Tuscaloosa formation of Alabama which will be figured in a report on the Cretaceous Floras of the Eastern Gulf region now going through the press of the United States Geological Survey.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

ROSALES

LEGUMINOSAE

COLUTEA Linné

COLUTEA PRIMORDIALIS Heer

Colutea primordialis Heer, Fl. Foss. Arct. **6**[2]: 99. *pl. 27. f. 7–11; pl. 43. f. 7, 8.* 1882.

This species was described from the Atane beds of west Greenland and subsequently recorded from the Dakota sandstone of Kansas, the Raritan formation of New Jersey, and the Magothy

formation of Marthas Vineyard, Long Island and Maryland. It is represented by a single specimen in the collection from the upper member of the Bingen sand.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

LEGUMINOSITES Bowerbank

LEGUMINOSITES OMPHALOBIOIDES Lesquereux

Leguminosites omphalobioides Lesquereux, Mon. U. S. Geol. Surv. **17**: 149. *pl. 38. f. 4.* 1892.

Leaflets elliptical in outline, 3.2–4 cm. in length by 1.5–1.7 cm. in greatest breadth, which is about half-way between the apex and the base. Texture subcoriaceous. Apex rather broadly rounded. Base slightly narrowed and decurrent to the point of attachment. Lesquereux speaks of a short petiole, but this is lacking in his type figure and in all the specimens examined by the writer. The midrib is not especially wide, but is quite prominent. The secondaries are thin and alternate; they number about six pairs, and branch from the midrib at angles of fifty degrees, or somewhat less, curving upward close to the margins, camptodrome.

This species was described originally from the Dakota sandstone of Kansas, and subsequently found in the Magothy formation of Maryland and the Tuscaloosa formation of Alabama. It is represented by a single, but characteristic specimen in the collection from the upper member of the Bingen sand.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

GERANIALES

EUPHORBIACEAE

MANIHOTITES Berry

MANIHOTITES GEORGIANA Berry

Manihotites georgiana Berry, Bull. Torrey Club **37**: 507. *f. 1, 2.* 1910; U. S. Dept. Int. Geol. Surv. Professional Paper 84: 114. *pls. 22; 23; 24. f. 4, 5.* 1914.

Leaves of extraordinarily large size, 36–48 cm. across, palmately and deeply lobate, the main lobes dichotomously sublobate. Base

missing, probably peltate. Margins entire, more or less undulate. Texture coriaceous. Venation coarse. Five or six stout primaries diverge at acute angles from the top of the petiole and fork dichotomously about 5–6 cm. above their base at angles of thirty to fifty degrees. These branches may again fork dichotomously in a distance of 4–6 cm., or may not give off any branches, or the branches may be clearly subsidiary in size and run to the apex of a subordinate lobe. There are a sparse number of relatively fine secondaries, which diverge at angles of about forty-five degrees or more and are apparently camptodrome. In each of the large specimens a straight vein of secondary size runs directly to the base of a single main sinus. It is possible that this vein diverges along the margin in a vein which forms a marginal hem, as in the sinuses of lobed sassafras leaves, but such a vein can not be made out, although at one point there is such a marginal vein connected with the main venation by straight transverse tertiaries. Deep and narrow but rounded sinuses approach within 3–5 cm. of the base and divide the leaf into five or more major lobes; these are subdivided by more or less deep sinuses of a similar character into inequilateral, ovate lanceolate, obtusely pointed subordinate lobes.

This remarkable species was described from perfect material from the lower Eutaw of western Georgia although the leaves are so large that it is usually represented by fragmentary specimens. It occurs in the Eutaw and Ripley of western Tennessee, in the Ripley of Georgia and in the Black Creek formation of North Carolina. Several broken specimens have been collected from the upper member of the Bingen sand.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

SAPINDALES

SAPINDACEAE

SAPINDUS Linné

SAPINDUS MORRISONI Heer

Sapindus Morrisoni Heer, Fl. Foss. Arct. **6**[2]: 96. *pl. 40. f. 1; pl. 41. f. 3; pl. 43. f. 1a, b; pl. 44. f. 7, 8.* 1882; Ibid. **7**: 39. *pl. 65. f. 5.* 1883.

Leaflets of variable, usually large size, lanceolate and more or less inequilateral in outline, with a broadly cuneate or rounded base and a pointed tip. Petiolulate. Texture subcoriaceous.

Margins entire. Midrib stout, curved. Secondaries numerous, camptodrome.

The present species was described originally by Heer, to whom it must be credited, from west Greenland although based on Lesquereux's manuscript which appeared in print the following year. It is common in the Dakota sandstone and in the Magothy formation of the northern Atlantic coastal plain and occurs in the Woodbine formation of the Western Gulf area, and the Tuscaloosa formation of the Eastern Gulf area. Not uncommon in both the lower and upper members of the Bingen sand.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County: Mine Creek, three and one half miles north of Nashville, Howard County.

THYMELEALES

LAURACEAE

CINNAMOMUM Blume

CINNAMOMUM NEWBERRYI Berry (?)

Cinnamomum intermedium Newberry, Fl. Amboy Clays, 89. *pl. 29. f. 1–8, 10.* 1896. Not Ettingshausen.

Cinnamomum Newberryi Berry, Bull. Torrey Bot. Club **38**: 423. 1911.

This widespread species has a considerable geological as well as geographical range. Found from western Greenland to Kansas, Iowa and Alabama it ranges from the lower Raritan upward to the lower Eutaw. It is common in the lower Tuscaloosa of western Alabama and is only doubtfully identified from the lower member of the Bingen sand.

OCCURRENCE: Mine Creek, three and one half miles north of Nashville, Howard County.

ERICALES

ERICACEAE

ANDROMEDA PARLATORII Heer

Andromeda Parlatorii Heer, Phyll. Crét. d. Nebr. 18. *pl. 1. f. 5.* 1866.

The species is found from Greenland to Nebraska and Alabama,

and from the Raritan upward to the Black Creek formation. It is common in the Tuscaloosa formation of western Alabama but has not heretofore been collected from the Upper Cretaceous of the Western Gulf area. It is present in the lower, but has not as yet been recognized in the upper member of the Bingen sand.

OCCURRENCE: Mine Creek, three and one half miles north of Nashville, Howard County.

ANDROMEDA NOVAE-CAESAREAE Hollick

Andromeda novae-caesareae Hollick; Newberry, Mon. U. S. Geol. Surv. **26**: 121. *pl. 42. f. 9–12, 28–31.* 1896; Berry, U. S. Dept. Int. Geol. Surv. Professional Paper 84: 58, 120. *pl. 14. f. 5, 6; pl. 24. f. 1.* 1914.

Leaves small, thick, and entire, with stout petioles and midribs and obscure secondary venation which is immersed in the thick lamina. Length 2.5–5.0 cm. Width varying from 0.9–1.3 cm. Venation, where visible, showing numerous parallel, camptodrome, relatively long and thin secondaries which branch from the midrib at acute angles. While the majority of these leaves are equally acuminate at both ends there is considerable variation in this respect, and a well-marked tendency is shown in a considerable number of specimens which are relatively broader, especially in the upper half, toward an obtusely rounded apex, the termination of the midrib showing as a small mucronate point. The base in these forms gradually narrows to the stout petiole.

This species is found as early as the uppermost Raritan in the New Jersey area and is also common in the everlying Magothy. It is exceedingly common throughout the Black Creek formation of the Carolinas and has also been recorded from the Cusseta sand member of the Ripley formation in Georgia, and from the Eutaw formation of Tennessee. It occurs also in the Woodbine of Texas and the Tuscaloosa of Alabama so that it is apparently a form with a wide stratigraphic range.

OCCURRENCE: Mine Creek, three and one half miles north of Nashville, Howard County.

POLEMONIALES

BORAGINACEAE

CORDIA Linné

CORDIA APICULATA (Hollick) Berry

Populus apiculata Hollick, Trans. N. Y. Acad. Sci. **12**: 4. *pl. 3. f. 2.* 1892.

Cordia apiculata Berry, Md. Geol. Surv. Upper Cretaceous, 897. *pl. 90. f. 6.* 1916.

Leaves variable in size and shape, ovate to orbicular in general outline, 5–10 cm. in length by 3–7 cm. in maximum width, which is at or below the middle. Apex usually somewhat abruptly produced into an acuminate tip. Base cuneate and slightly decurrent to rounded or almost truncate. Margins entire, sometimes slightly repand. Petiole of medium length, stout. Midrib mediumly stout, often flexuous. Secondaries five or six pairs, subopposite below, alternate above, slender, branching from the midrib at angles of from forty-five to fifty degrees and arching upward, camptodrome. Tertiaries camptodrome in the marginal region, percurrent internally.

This species in all its characters suggests most strongly the existing *Cordia sebestena* Linné which ranges from the Florida Keys to New Guinea. It also suggests *Cordia tremula* Griesbach of the West Indies, and there is a general generic likeness to various other existing species of this genus. *Cordia* leaves are variable and tend to have more or less toothed margins as is sometimes the case in *Cordia sebestena*, but they are in general entire or slightly repand, and like the fossil somewhat variable. *Cordia* is certainly represented in the Lower Eocene flora of the Gulf region by forms that may be descendants of this Upper Cretaceous species. The present form has been recorded from New Jersey, Staten Island, Long Island, and Delaware, and is not rare in the lower beds of the Tuscaloosa formation in the Alabama region.

Represented by a single specimen in the present collection from the upper member of the Bingen sand.

OCCURRENCE: Big Railroad Cut, one mile southwest of Maxwell Spur, Pike County.

JOHNS HOPKINS UNIVERSITY,
BALTIMORE

Explanation of plate 4

SEQUOIA CONCINNA Heer

FIG. 1. Foliage from the Bingen sand.

FIG. 2. Cone from the Bingen sand.

FIGS. 3–5. Heretofore unfigured cones from the Magothy formation at Cliffwood Bluff, New Jersey.

DEWALQUEA INSIGNIFORMIS Berry

FIG. 6. Showing the leaf habit.

FIG. 7. Showing venation, × 3.

Notes on the genus Herberta, with a revision of the species known from Europe, Canada and the United States*

ALEXANDER W. EVANS

(WITH PLATE 8 AND 29 TEXT FIGURES)

INTRODUCTION

The genus *Herberta* (or *Herbertus*, as it was originally spelled) was published by S. F. Gray in 1821.† It was named in honor of George Herbert, one of the patrons of Micheli, and was based on a single species, the *Jungermannia adunca* of Dickson. In common with Gray's other genera, *Herberta* was ignored by botanical writers until Carruthers called attention to it in 1865.‡ Although it has since been accepted more or less widely in both Europe and North America, a strong tendency has recently arisen to repudiate it. This is largely due to Gray's unfortunate practice of giving his generic names a masculine termination, even when he derived them from the names of persons. As Dumortier expresses it, they are the names of men and not of plants. Since, however, a change from a masculine to a feminine termination might readily be construed as the correction of an error in orthography, this objection seems hardly sufficient to justify the setting aside of Gray's genera altogether. From a scientific standpoint the claims of *Herberta* are fully as good as those of many other genera which are accepted without question, and the writer is therefore disposed to recognize it, at least for the present.

A year after the appearance of *Herberta*, Dumortier§ published his genus *Schisma*, including under it not only *J. adunca* but also *J. juniperina* Sw. and *J. concinnata* Lightf. Nine years later he added another species, *S. stramineum* Dumort.,‖ but excluded *J. concinnata*, making it the type of his new genus *Acolea*. At

* Contribution from the Osborn Botanical Laboratory.

† Nat. Arr. British Pl. 1: 705. 1821.

‡ Jour. Bot. 3: 300. 1865.

§ Comm. Bot. 114. 1822.

‖ Syll. Jung. 76. 1831.

that time he was undoubtedly ignorant of Gray's writings. Many years afterwards, however, in his last published work on the Hepaticae,* he quotes Gray's generic names as synonyms, refusing to recognize them as valid on account of their masculine form. In the present instance he naturally maintains his genus *Schisma*. Gray's genera were likewise unknown to Nees von Esenbeck. In the first volume of his Naturgeschichte der europäischen Lebermoose, published in 1833, he accepted *Schisma* as valid (p. 107). In the third volume, published in 1838, he suggested that it might be considered a section of his genus *Mastigophora* (p. 573), although he continued to employ *Schisma* as a generic name. The inclusion of *Schisma* under *Mastigophora* would have been quite unwarranted on the basis of priority. The latter genus was not published until 1833, and its characters were completely revised in 1835. *Schisma* therefore antedates it by more than a decade. As originally defined *Mastigophora* was essentially the equivalent of the genus *Lepidozia* Dumort., although no species were definitely assigned to it; in its revised form it was made to include such species as *Jungermannia diclados* Brid. and *J. Woodsii* Hook. At the present time it is accepted by most writers in its revised form.

Nees von Esenbeck's provisional reduction was adopted definitely by the authors of the Synopsis Hepaticarum (1845), who went even farther than he and included both *Schisma* and *Mastigophora* under the genus *Sendtnera* of Endlicher,† a genus which had been proposed a few years earlier for the single species *Jungermannia Woodsii*. On account of the high position which the Synopsis holds in the literature of the Hepaticae the name *Sendtnera* was acknowledged for many years as the correct name for the combined genus. Now, however, both *Schisma* and *Mastigophora* are universally regarded as distinct, and the name *Schisma* is employed by those who refuse to sanction the use of the name *Herberta*.

Of the eighteen species of *Sendtnera* given in the Synopsis only six would now be included in the genus *Herberta*. In Stephani's recent monograph of the genus (under the name *Schisma*), pub-

* Bull. Soc. Bot. Belgique **13**: 123. 1874.

† Gen. Plant. 1342. 1840.

lished in 1909,* seventy-one species are recognized. According to the information at hand four species have since been described, making seventy-five in all. This marked increase is due partly to the more extensive material at the disposal of recent writers and partly to their narrower interpretation of species. Of the seventy-one species admitted by Stephani nearly all have a very limited geographical range and no fewer than forty-seven are described as new. Taking into account the species of his monograph and those since published, two are restricted to Europe, thirteen to Africa (including the Azores), sixteen to Asia (including the Philippines), seven to various islands of the Pacific, ten to tropical North America, and twenty-six to South America; Stephani gives one species a wider range, including Samoa, Tahiti, Hawaii, Japan, and Himalaya. It is interesting to note that he accredits no species to North America north of Mexico, although *H. adunca*, a species which he restricts to Europe, has been repeatedly reported by American writers, not only from Alaska and British Columbia but also from the eastern United States.

The species of *Herberta* grow on rocks, on trees, and on the ground and sometimes form extensive mats or tufts. In the tropics they seem to be confined to higher altitudes, but the few species which occur in temperate and frigid regions sometimes descend to the level of the sea, this being true in both hemispheres. The plants are usually marked by a yellowish or brownish color, due to a pigmentation of the cell walls. In rare cases a reddish or purplish tinge is present, and in sheltered stations the pigmentation may be so slight that the plants appear green.

NOTES ON THE MORPHOLOGY OF THE GENUS

In its morphological features *Herberta* is one of the most clearly defined and natural genera of the Hepaticae. The gametophyte consists of a prostrate rhizome which gives rise to numerous secondary stems. These sometimes remain simple, even when they become comparatively long, and sometimes branch sparingly. The subequally bifid leaves are slightly incubous while the underleaves are strictly transverse, and yet, since the underleaves are nearly or quite as large as the leaves and similar to them in most

* Spec. Hepat. 4: 1–30. 1909.

other respects, the shoots appear almost radial in structure. The inflorescence is invariably dioicous. The androecium is at first terminal on a secondary stem or one of its branches but soon proliferates, and the male shoot eventually shows a series of short intercalary androecia separated by equally short sections bearing normal leaves. The archegonia are likewise terminal on secondary stems. When fertilization takes place the growth of the female stem is usually brought to an end; when fertilization does not take place one or more subfloral innovations may be produced. The involucre is composed of crowded bracts and bracteoles, which are essentially alike and not very different from the leaves, while the perianth is deeply laciniate at the mouth and free or nearly so from the bracts. The calyptra and the sporophyte conform to the usual jungermanniaceous type.

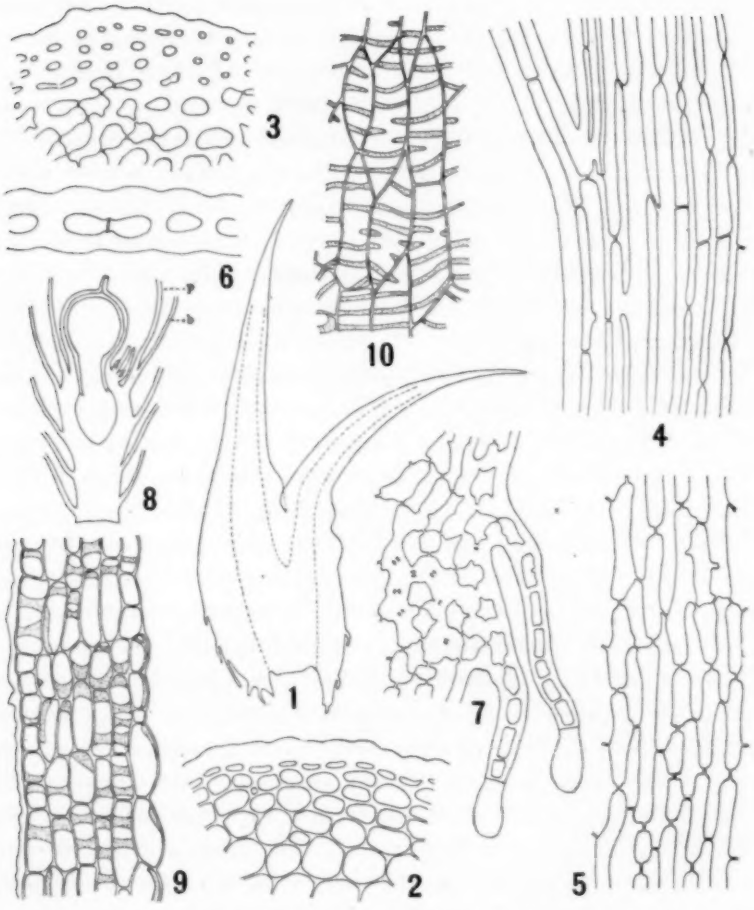
The rhizome of *Herberta* was apparently overlooked by the older writers. Spruce,* however, calls attention to it and to the fact that it may bear rhizoids, while Stephani mentions its small diameter and copious branching. It tends, in fact, to be considerably more slender than the secondary stems, although both vary in size. In *H. juniperina*, for example, an average rhizome measures only 0.35 × 0.25 mm. in cross section, while a stem measures 0.5 × 0.35. The features of the rhizome are not easily made out in material where the secondary stems are well developed. The leaves are more or less disintegrated with age and it is difficult to demonstrate the relationship between the branches and the leaves. In most cases the leaves and underleaves are minute and widely separated. The leaves are practically transverse in their insertion and it would be difficult to distinguish them from the underleaves, if the rhizome did not show a slight dorsiventral flattening, the underleaves being of course situated on one of the flattened sides. Both leaves and underleaves are distinctly bifid. The rhizoids grow out normally from the basal cells of the underleaves, although they often occur on the leaves as well, but the rhizome itself is usually free from them. The branches are all intercalary and many of them spring from the axils of the underleaves. This position, however, is not constant; occasional branches tend to be lateral and do not show a definite relationship

* Trans. Bot. Soc. Edinburgh 15: 340. 1885.

to either leaves or underleaves. It is of course possible that their aberrant position is due to secondary displacements caused by inequalities of growth, but this could not be definitely determined from the material studied. The secondary stems are sometimes direct extensions of the creeping rhizomes, but it is usually possible to demonstrate their origin as branches. Even under these circumstances they usually bear small leaves at the base and only gradually give rise to the normal leaves. Sometimes the change is more abrupt, and all gradations may be present between the small-leaved prostrate rhizomes and the typical secondary stems with large leaves.

The secondary stems differ greatly in length in different species and even in the same species under varying conditions. In some of the robust tropical species a length of 25 cm. may be attained. The stems are usually ascending but are often pendulous and sometimes form conspicuous festoons hanging from the branches of trees. The branches are always intercalary, just as in the case of the rhizomes. The normal vegetative branches take their origin in the axils of underleaves and are rarely subdivided. In most cases they spread widely and show a flagelliform appearance, their leaves being distinctly smaller than those of the stem. When the growing point of a stem is injured, however, a ventral branch sometimes changes its direction of growth and assumes that of the stem, its leaves at the same time increasing in size. The same thing is true of the subfloral innovations, which may be either ventral or lateral in position. The growth of the stem is here brought to an end by the development of the archegonia. Rhizoids are often absent altogether from the secondary stems. When they occur they are usually restricted to the underleaves and leaves of the ventral branches, although the normal leaves and underleaves have the power of developing them.

The leaves (TEXT FIGS. 1, 14, 15, 21–25) and underleaves of the secondary stems present a great deal of uniformity throughout the genus. They are more or less deeply bifid with a narrow sinus and sharp divisions. In rare cases a leaf may be trifid instead of bifid, a peculiarity to which certain species seem to be more subject than others. The divisions are sometimes distinctly grooved but show little tendency to be complicate, both lying approximately in



FIGS 1–10. HERBERTA JUNIPERINA (Sw.) Trevis.

1. Leaf, × 17. 2. Transverse section of a young stem, × 225. 3. Transverse section of a mature stem, × 225. 4. Longitudinal section of a mature stem, including the base of a leaf, × 225. 5. Cells from the basal vitta of a leaf, × 225. 6. Cells from the basal vitta of a leaf in transverse section, × 300. 7. Cells from the dorsal base of a leaf, showing cilia with slime papillae, × 225. 8. Longitudinal section of a young sporophyte and surrounding parts, × 17; *b*, innermost perichaetial bract; *p*, perianth. 9. Transverse section of the wall of a mature capsule, × 225. 10. Cells from the innermost layer of the wall of a mature capsule. × 225. FIGS. 1, 5–7 were drawn from specimens collected by the writer on Blue Mountain Peak, Jamaica, *242*; FIGS. 2–4, 6, from specimens collected by L. M. Underwood along the trail from Cinchona to Morce's Gap, Jamaica, *280*; the remaining figures, from specimens collected by W. Harris on the lower slopes of Sir John Peak, Jamaica, *11133*.

the same plane. At the base on each side a series of slime papillae or their vestiges can be demonstrated. These are sometimes sessile (TEXT FIG. 17) and sometimes borne on the tips of more or less evident teeth or cilia (TEXT FIG. 7; PLATE 8, FIG. 5). Occasionally slime papillae with their teeth are developed on the surfaces of the leaves and underleaves, as well as on their margins. The teeth vary from short stalks a cell or two long to broad and subdivided lobe-like structures. Except for the basal teeth associated with the slime papillae the margins are usually quite entire. In a few species, however, distinct teeth are present higher up, even beyond the region of the sinus, and these teeth show no evidences of slime papillae. Even when teeth of this character are present the upper parts of the divisions lack them completely. A vague serrulation, caused by projecting cells, may sometimes be discernible but seems to be a very exceptional feature.

Aside from the difference in insertion there are certain other slight differences between the leaves and underleaves. The leaves are usually curved backward and appear unsymmetrical when dissected from the stems and spread out flat. The curvature affects the ventral division more strongly than the dorsal division (PLATE 8, FIGS. 1–3); the latter in fact may be straight or nearly so while the ventral division is strongly curved (TEXT FIG. 1). In some species the curvature is much less pronounced than in others and may not be evident at all in explanate leaves (TEXT FIGS. 22–25); the lack of symmetry, however, still expresses itself in a difference of direction of the divisions and in a greater development of the basal portion on the dorsal side. The underleaves bend backward in a squarrose fashion and appear symmetrical when spread out, their straight divisions diverging equally and the basal portion being equally developed on the two sides. The leaves and underleaves are usually more or less imbricated. The divisions of the curved leaves and squarrose underleaves are thus crowded together along the ventral portion of the shoot, the plant acquiring a distinctly moss-like appearance.

The cells and especially the cell-walls yield some of the most distinctive characters of the genus. Most of the walls are strongly thickened and this applies even to the rhizoids when they become

old. According to Goebel* excessive thickening of the cell walls in the bryophytes, which occurs especially in xerophilous species, is significant on account of the great power of imbibition which these walls possess. They readily absorb and retain water, and the rapidity with which most species of *Herberta* regain their normal appearance and consistency, when a dry tuft is deluged with water, is a striking phenomenon. In the cauline portions of the plant the cells are all elongated, although they never assume a truly prosenchymatous character. The outer or cortical region is distinguished from the inner or axial region by its deeper color and more strongly thickened walls. In the secondary stems the thickening at first takes place in the outermost layer of cells, the process continuing until the cell cavities become reduced to narrow canals (TEXT FIG. 2). The thickening is largely restricted to the outer or superficial walls and the layer presents the appearance of an epidermis with well-developed cuticle. In some cases the entire cortex consists of this outermost layer, the walls of the remaining cells showing only a slight degree of thickening (TEXT FIG. 26). This, however, is very unusual. In the majority of cases two or more additional layers take part in the formation of the cortical region; their walls become as markedly thickened as those of the outermost layer, the only difference being that the thickening is deposited uniformly on all the walls (TEXT FIG. 3). Even in the central region the thickening of the walls is sometimes very pronounced, though never so much so as in the cortical region. Since, moreover, the central cells are larger than the cortical cells, their cavities remain distinctly wider. The cells of the stem are everywhere connected by pits, which show clearly in both transverse and longitudinal walls (TEXT FIGS. 3, 4). They are just as evident in the superficial layer as elsewhere, the cells of this layer being connected with one another both longitudinally and tangentially, as well as with the cells of the layer next within. There is nothing, in fact, to indicate any essential difference in function between the superficial layer and the other cortical layers. In spite of the fact that the outer walls simulate a cuticle so strongly, they have the same powers of imbibition as the other walls and simply form part of the imbibing system of the stem. In the rhizomes the

* See Organographie der Pflanzen, 2d ed. 553. 1915.

same distinction between cortical and central regions is apparent. There is perhaps a tendency for the cortical region to be thinner and for the cell-walls of the central region to be less thickened than in the secondary stems, but there are no essential differences between the two.

The leaf-cells in their more important features have long been familiar to students of the Hepaticae. Although forming a single layer as in most of the Jungermanniaceae the cells show a differentiation into elongated cells and more or less isodiametric cells (see, for example, PLATE 8, FIG. 4). The elongated cells form a median band extending from the line of insertion into the basal portion of the leaf. Somewhere below the sinus the band, or "vitta," as Stephani terms it, forks, one branch passing into each division. Here they may extend to the extreme apices or stop at a variable distance below them. The isodiametric cells form the rest of the leaf and are divided into three patches by the vitta and its branches, the two lateral patches extending from the base into the divisions on their outer sides and the median patch from the forking of the vitta into the divisions on their inner sides. Apparently the first allusion to the vitta is found in the original description of *H. dicrana* (Tayl.) Trevis.* In a critical note, quoted from Taylor, a "nerve" is spoken of which runs out into the divisions. Gottsche afterward described the vitta in other species, and Stephani lays especial emphasis on it in his recent monograph. In his opinion the vitta yields some of the best differential characters in distinguishing species. He considers the basal portion (below the forking) to be constant in size for a given species, and he finds an equal constancy in the length of the branches. Unfortunately it is not always easy to determine the exact lateral boundaries of the vitta or the points where the branches terminate in the divisions of the leaves. Although the median cells of the basal portion are markedly different from the cells near the margin of the leaf, there is sometimes a gradual transition between the vitta and the marginal portion, and a similar transition may exist between the cells of the vitta and the marginal and apical cells of the divisions. Two observers, in consequence, might obtain different results in measuring the same

* Syn. Hep. 239. 1845.

leaf. A case in point is found in *H. adunca*. According to Stephani the branches of the vitta come to an end below the apices of the divisions; according to K. Müller they extend to the apices. At the same time the value of the vitta from the standpoint of taxonomy must not be overlooked, and Stephani deserves credit for utilizing it.

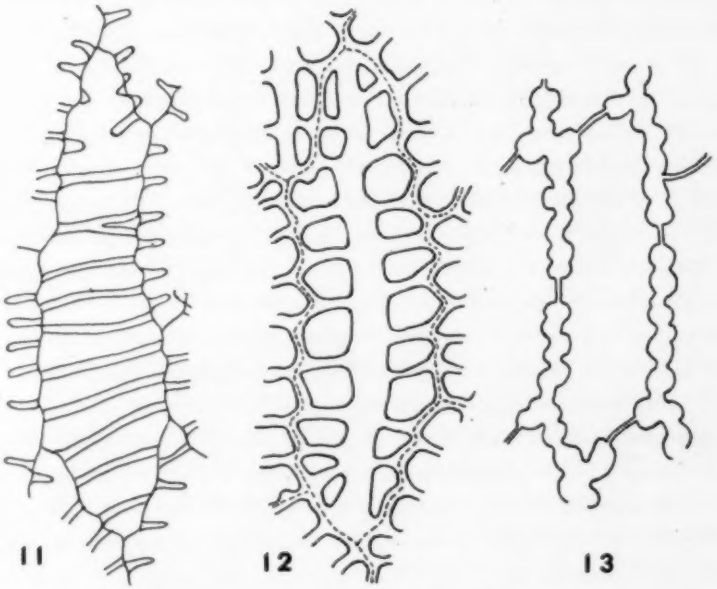
The cells of the vitta present a number of interesting peculiarities, not only in their structure at maturity but also in their development, especially in the way in which the thickenings of the wall are deposited. Gottsche, in his account of *H. juniperina*,* noted some of these peculiarities many years ago, but subsequent allusions to them have been very scanty. According to Gottsche each basal cell of the leaf, after treatment with caustic potash and iodide of zinc, reveals a spiral of eight to fifteen turns representing a thickening of the secondary layer of the wall. In a later account† of the same species he gives the number of turns as fifteen to twenty-two.

By treating young leaves with potash it is easy to demonstrate the presence of the bands of thickening described by Gottsche, not only in the basal portion of the leaf but elsewhere, and they clearly represent a stage in the development of the cell wall (TEXT FIG. 11). The writer has found it impossible, however, to show that the bands form a continuous spiral. They seem to be rather in the form of separate rings or partial rings, an occasional ring being branched. When the rings are incomplete the gaps occur on the free walls of the cell and never on the vertical walls, which separate the cell from its neighbors. Even under these circumstances, however, the bands of thickening extend partially across the free walls and leave only the median portion thin throughout. The bands of one cell do not lie opposite the bands of adjoining cells but tend to alternate with them. The vertical walls show a zigzag appearance where they meet the free walls, each angle of the zigzag marking the position of one of the bands. In the irregular cells between the vitta and the margin the bands are more irregular than in the cells of the vitta and rarely if ever form complete rings. In other respects they are essentially the same.

* Rabenhorst, Hep. Eur. *210*, accompanying text.

† Mex. Leverm. 138. 1863.

The bands of thickening just described soon become united by median bands laid down on the free walls (TEXT FIG. 12). These leave a series of thin places on each side, which show at first angular outlines. Almost simultaneously the bands on the vertical walls increase in thickness and become connected by deposits laid down between them, the result being that these walls acquire a



FIGS. 11–13. HERBERTA JUNIPERINA (Sw.) Trevis.

11. Very young cell from the basal vitta of a leaf, surface view, × 1,000. 12. Somewhat older cell from same vitta, surface view, × 1,000. 13. Still older cell from same vitta, optical section, × 600. The figures were all drawn from specimens collected by L. M. Underwood along the trail from Cinchona to Morce's Gap, Jamaica, *280*.

continuous layer of thickening except for an occasional pit. At first the original bands are thickened more conspicuously than the intermediate regions and the vertical walls appear distinctly scalloped when examined in optical section (TEXT FIG. 13). But the conditions just described are temporary. The thin places in the free walls are gradually filled up by deposits of thickening, becoming rounded as they diminish in size, and the depressions between the scallops along the vertical walls become obliterated

in much the same way. The entire cell-cavity is eventually lined by a uniformly thick layer of deposit, the only thin places left being the pits in the vertical walls (TEXT FIGS 5, 6). Even some of the pits may be obliterated with age. When this takes place the deposit either fills the pit-chamber altogether or bridges it across, leaving a minute vestige of the chamber next to the closing membrane (TEXT FIG. 7). When the cells are mature it is sometimes possible to detect evidences of the original bands of thickening and of the scallops along the vertical walls, but the free walls present an absolutely uniform appearance. Although the thickenings look very much as if they were formed by the coalescence of trigones and intermediate thickenings, it is clear from their method of development that they are not directly comparable with the trigones and intermediate thickenings of other Hepaticae.

Although the description just drawn from *H. juniperina* probably applies in its essential features to the entire genus, the details are not always as clear in some of the other species. In *H. adunca*, for example, it is difficult to demonstrate bands of thickening except in the basal portion of the vitta, and it is doubtful if they ever form complete rings. The scalloped appearance of the vertical walls is likewise much less evident. Possibly the more indefinite conditions found are associated with the fact that the thickening of the walls in *H. adunca* is usually much less marked than in *H. juniperina*.

The leaf surface in *Herberta*, the so-called cuticle of authors, is striolate or verruculose. The roughness is sometimes very apparent and sometimes made out with difficulty. Whether differences in the degree of roughness yield constant differential characters in separating species is perhaps doubtful, although such differences seem very striking when certain species are compared.

The androecia in *Herberta* are relatively short and usually include from four to eight pairs of bracts, those at the upper and lower ends being somewhat transitional in character. The male plants tend to produce smaller leaves than female plants or vigorous sterile plants, and although the bracts are considerably larger than the leaves borne between the successive androecia, they scarcely equal in size the normal leaves on female individuals. Several years ago Schiffner made the remarkable discovery that

antheridia occur not only in the axils of the bracts but also in the axils of the bracteoles.* In order to determine whether this phenomenon was widespread among the Ptilidioideae, to which group *Herberta* is usually assigned, he examined species of several other genera. The closely related *Mastigophora*, however, was the only one in which he was able to observe antheridial bracteoles. In the case of *Herberta* the bracteoles differ from the bracts in about the same way that the ordinary underleaves differ from the leaves. Both bracts (TEXT FIG. 20; PLATE 8, FIGS. 8, 9) and bracteoles are more or less imbricated and have a broad inflated pocket at the base enclosing a cluster of two or more antheridia. The pocket does not involve the entire width of the basal region but leaves a narrow flattish or revolute strip on each side. In the inflated portion the cells are broader and much paler than ordinary cells, and the thickenings of the walls are more irregular in outline and less strongly developed. The divisions, sinus, and margins are much the same as on ordinary leaves.

The perichaetial bracts (PLATE 8, FIGS. 10, 11) and bracteoles are essentially alike. They occur in three or four closely crowded series and increase somewhat in size toward the perianth, only the apical portion of which projects beyond them. Those of the innermost series, when viewed from the outer surface, show two rounded ridges in the basal portion, separated by a narrow median groove. A marginal band on each side is flat or slightly concave. The divisions are much the same as on ordinary leaves but the margins are much more toothed, the teeth being irregular and extending higher up, sometimes almost to the apices of the divisions. Occasionally minute and irregular paraphyllia (PLATE 8, FIG. 12) with marginal papillae are found among the bracts. According to Spruce the bracts closely embrace the perianth but are free from it throughout their entire length; according to Stephani they are coalescent with the perianth up to a considerable height. A longitudinal section through a young sporophyte and surrounding parts (TEXT FIG. 8) shows that Spruce was essentially correct. Any coalescence which may be present is so slight as to be practically negligible. Between the innermost bracts and bracteole and the leaves below the involucre there is a gradual transition.

* Untersuchungen über Amphigastrial-Antheridien und über den Bau der Andröcien der Ptilidioideen. Hedwigia **50**: 146–162. *f 1–39* 1910.

The perianth of *Herberta*, when well developed, clearly supports the theory that three floral leaves take part in the formation of this organ (PLATE 8, FIG. 13). It is split for nearly half its length into six slender laciniae, essentially like divisions of leaves, every alternate split being a little deeper than the others. These deeper splits mark the boundaries of the three coalescent leaves. In the undivided portion of the perianth a cross section shows that six rounded ridges are present, separated by six rounded grooves (PLATE 8, FIG. 14). Three alternate grooves are deeper than the others and correspond with the three deeper splits at the mouth of the perianth. The innermost bracts and bracteoles, each with its two dorsal ridges separated by a groove, are closely appressed to the ridges and grooves of the perianth. The laciniae of the perianth bear numerous slime-papillae and often teeth. The slime papillae occur not only along the margins of the laciniae toward the base but also on the inner surface of the perianth. Here they sometimes form short rows and sometimes show no regular arrangement. The surface papillae are occasionally borne on the tips of short teeth or along the margins of narrow and irregular ridges. In some cases the perianth is not developed normally. More than six laciniae, for example, may be present at the mouth, or one of the splits may extend to the very base; sometimes both of these abnormalities may be seen in a single perianth. An increase in the number of laciniae is not surprising, since ordinary vegetative leaves with three divisions sometimes occur, and the deep split might plausibly be interpreted as a place where coalescence had failed to take place.

The wall of the capsule is described in its essential features by Spruce. It is composed of from five to seven layers of cells (TEXT FIG. 9) and shows a thickness of 70–100 μ. This is considerably more than in most of the leafy Hepaticae studied by Andreas.* In *Plagiochila asplenioides* (L.) Dumort., for example, where the wall is composed of seven or eight layers, the thickness is only 55 μ, while in *Chiloscyphus polyanthus* (L.) Corda, where the wall is composed of five layers, the thickness is only 25 μ. It is less, however, in *Herberta* than in *Pleurozia purpurea* (Lightf.)

* Ueber den Bau der Wand und die Oeffnungsweise des Lebermoossporogons. Flora **86**: 161–213. *pl. 12+f. 1–25.* 1899.

Lindb.; in this species, according to Andreas, the wall is composed of seven or eight layers and has a thickness of 130 μ. In all these forms he describes local thickenings in the cells of all the layers. In the innermost layers the thickenings are in the form of half rings extending across the inner tangential wall (see TEXT FIG. 10) In the other layers they are in the form of bands on the radial walls. Even here, however, the bands sometimes extend to a greater or less extent along the tangential walls. According to Andreas the structure of the capsule wall in the leafy Hepaticae shows comparatively little variation, and the genus *Herberta* agrees on the whole with his account. It might be added that the valves are covered on the outside by a granular wax-like deposit, and that secondary splits sometimes occur in one or more of the four primary valves.

Many years ago Spruce* described the occurrence of rudimentary shoots on the leaves of *Herberta*. According to his account they arise singly or in pairs from the cells of the vitta in the basal portion of the leaves and never in the divisions. These shoots have not been observed by the writer and are probably developed under exceptional conditions. They represent the only type of vegetative reproduction known in the genus. As Spruce's figures clearly show, the shoots bear three ranks of small bifid leaves and show no signs of dorsiventrality. They resemble in many respects the adventive shoots borne on the leaves of certain species of *Plagiochila*, although they are much less abundantly produced.

REVISION OF THE SPECIES KNOWN FROM EUROPE, CANADA AND THE UNITED STATES

According to most recent writers on the Hepaticae the genus *Herberta* is represented in Europe by only two species. The first of these is *H. adunca* (Dicks.) S. F. Gray, the type of the genus; the second, *H. Sendtneri* (Nees), sometimes known as *H. straminea* (Dumort.) Trevis. The range of *H. adunca*, according to available records, is restricted to Norway, the Faroe Islands and the British Isles; the range of *H. Sendtneri* is even more circumscribed, being accredited only to the Austrian and Bavarian Alps.

* On the branch-bearing leaves of *Jungermannia juniperina*, Sw. Phytologist 2: 85, 86. 1844. [Illust.]

In thus restricting the range of the latter species, writers differ markedly from Dumortier.* He considered that his *Schisma stramineum*, under which he included *S. Sendtneri* Nees as a synonym, grew in Scotland, as well as in Austria and Germany. His species, in fact, was based on Scottish material. Apparently his only recent follower is Lett,† who admits both *H. adunca* and *H. straminea* as members of the Scottish flora.

Botanists have long recognized the fact, however, that *H. adunca* includes two well-marked forms. These were distinguished by Gottsche,‡ as long ago as 1862, under the names, *α Dicksoniana* and *β Hutchinsiae*. He applied the first name to the plant with shorter, erect-spreading leaves, having straight acuminate divisions, and the second to the plant with longer leaves, hooked when dry and squarrose when moist, having lanceolate, incurved divisions. He considered that *α Dicksoniana* was primarily a plant of Scotland while *β Hutchinsiae* was primarily a plant of Ireland, and yet he made no attempt to restrict the range of either form definitely. Carrington,§ in taking up the name *β Hutchinsiae*, implies that all the Irish specimens are referable to this form and states that the species grows at much lower altitudes in Ireland than in Scotland. He adds that both forms grow in Scotland, the form with ovate or ovate-lanceolate leaves being restricted to higher and exposed mountains. This form is clearly Gottsche's *α Dicksoniana*, although Carrington does not call it by this name. He includes under it Dumortier's *S. stramineum* as a synonym and calls attention to the fact that it approaches *H. Sendtneri*. Although subsequent British writers have paid little attention to Gottsche's names, Schiffner has recently revived them and applied them to specimens in his exsiccatae.‖

From a careful study of European specimens referred to *H. adunca*, the writer has reached the conclusion that Gottsche's two so-called forms represent two distinct, but closely related, species. The form *α Dicksoniana*, as its name implies, represents the type of *Jungermannia adunca* Dicks. In the absence of Dickson's original

* Bull. Soc. Bot. Belgique **13**: 125. 1874.

† Hepat. British Isl. 177. 1902.

‡ Rabenhorst, Hep. Eur. *210*. 1862.

§ Trans. Bot. Soc. Edinburgh **7**: 454. 1863.

‖ Hep. Eur. Exsic. *403–407*. 1912.

material, the statement is supported by Scottish specimens in the Taylor herbarium, received from Hooker, and by the fact that Dickson's plant was collected "in alpibus Scoticis." The type of Dumortier's *Schisma stramineum* was likewise collected "in alpibus Scotiae" and, in the complete absence of all of Dumortier's types, his species may be regarded as a simple synonym of *H. adunca*. The second form, *β Hutchinsiae*, is described below as a new species under the name *H. Hutchinsiae* (Gottsche). In certain respects the true *H. adunca*, as thus restricted, resembles *H. Sendtneri* more strongly than it does *H. Hutchinsiae*. This would account for the fact that Dumortier failed to distinguish between his *Schisma stramineum* and *H. Sendtneri*. The latter species, however, is clearly distinct, and there is no evidence that its range extends beyond the mountains of Austria and Germany.

With regard to the North American specimens which have been referred to *H. adunca*, there has likewise been confusion. There are apparently two species represented, but neither agrees with typical *H. adunca*. The plant from the eastern United States seems to be new and is described below under the name *H. tenuis;* the plant from the Pacific Coast, on the contrary, seems to be referable to *H. Hutchinsiae*. The Alaskan material of this species is unusually satisfactory because it shows androecia, perianths, and sporophytes, all of which are exceedingly rare in European material. The four species considered in the present paper may be distinguished as follows, only vegetative characters being used:

Leaves mostly 1.2–2 mm. long and 0.45–0.9 mm. wide.
- Leaves bifid about one half; divisions broad, slightly or not at all curved, acute to acuminate; vitta not distinct, the cells in the divisions mostly 20–40 μ long.
  - Basal portion of leaves normally entire. 1. *H. adunca.*
  - Basal portion of leaves sparingly and coarsely toothed. 2. *H. Sendtneri.*
- Leaves bifid two thirds to four fifths; divisions narrow, strongly curved, long-acuminate; vitta distinct, the cells in the divisions often 50–70 μ long; basal portion of leaves entire or nearly so. 3. *H. Hutchinsiae.*

Leaves mostly 0.9–1 mm. long and 0.3–0.35 mm. wide, bifid two thirds to three fourths; divisions narrow, slightly or not at all curved, long-acuminate; vitta distinct, the cells in the divisions often 50–70 μ long; basal portion entire or sparingly and coarsely toothed. 4. *H. tenuis.*

1. HERBERTA ADUNCA (Dicks.) S. F. Gray

Jungermannia adunca Dicks. Plant. Crypt. Brit. **3**: 12. *pl. 8, f. 8.* 1793.

Jungermannia juniperina β Hook. Brit. Jung. *pl. 4.* 1812 (in part).

Herberta adunca S. F. Gray, Nat. Arr. Brit. Pl. **1**: 705. 1821.

Schisma aduncum Dumort. Comm. Bot. 114. 1822.

Jungermannia juniperina β *adunca* Lindenb. Nova Acta Acad. Leop.-Carol. **14** (suppl.): 35. 1829 (in part).

Schisma stramineum Dumort. Syll. Jung. 76. 1831; Bull. Soc. Bot. Belgique **13**: 125. 1874 (in part).

Schisma juniperinum β Nees, Naturg. Europ. Leberm. **1**: 108. 1833.

Sendtnera juniperina β Nees; G. L. & N. Syn. Hep. 239. 1845.

Sendtnera straminea Nees, *l.c.* 240. 1845.

Sendtnera adunca α *Dicksoniana* Gottsche; Rabenhorst, Hep. Eur. *210* (accompanying text). 1862.

Herberta straminea Trevis. Mem. R. Ist. Lomb. III. **4**: 396. 1877 (in part).

Herberta adunca var. *straminea* Cooke, Handb. Brit. Hepat. 70. 1894.

Herberta adunca var. *alpina* Macvicar, Student's Handb. Brit. Hepat. 340. 1912.

Herberta adunca α *Dicksoniana* Schiffn. Lotos **60**: 53. 1912.

Yellowish or brownish green, often tinged with red or purple, sometimes slightly glossy, growing in more or less extensive mats, or scattered among other bryophytes: secondary stems erect or ascending, sparingly and irregularly branched, rigid, mostly 5–10 cm. long but sometimes shorter, about 0.25 mm. (or fourteen cells) wide and 0.18 mm. (or ten cells) thick, the cells everywhere with strongly thickened walls: leaves imbricated, more or less secund, unsymmetrical, ovate, mostly 1.2–1.4 long and 0.45–0.6 mm. wide, bifid about one half, the divisions (in explanate leaves) slightly or not at all curved, acute to acuminate, mostly 0.6–0.7 mm. long and 0.27–0.35 mm. wide at base, margin normally entire; vitta usually indistinct even in the basal region, extending for a short distance into the division but coming to an end considerably below the apex, undivided portion usually 0.2–0.3 mm. long and wide; cells of vitta mostly 35–60 × 22 μ in the basal portion and 20–40 × 20 μ in the divisions, marginal cells in basal portion

about 22 μ in diameter, cells between margin and vitta about 24 μ in diameter; thickenings distinct, in the vertical walls mostly 8–10 μ wide; cuticle scarcely striolate: underleaves similar to the leaves but squarrose and symmetrical: male inflorescences borne in an interrupted series in the upper part of a stem; bracts mostly in five or six pairs, similar to the leaves except for the broad basal pocket extending nearly to the sinus, margin normally entire; bracteoles similar to the bracts; antheridia mostly two or three in each axil: female inflorescence not seen. [TEXT FIGS. 14–20.]

The following specimens have been examined:

NORWAY: Drivandefossen Waterfall, Lyster, Bergen Stift, August, 1900, *B. Kaalaas* (listed by Kaalaas in Nyt. Mag. f. Naturv. **40**: 247. 1902; distributed as *H. adunca* α *Dicksoniana* in Schiffner's Hep. Eur. Exsic. *465*); Söndfjord, Bergen Stift, July, 1903, *E. Jörgensen* (distributed as *H. adunca* α *Dicksoniana* by Schiffner, *l.c. 464*); Frafjord near Stavanger, July, 1899, *E. Jörgensen* (distributed as *H. adunca* α *Dicksoniana* by Schiffner, *l.c. 463;* specimens from same locality listed by Kaalaas, *l.c.* **33**: 224. 1893).

FAROE ISLANDS: Syderö, Bordö and Vaagö, May and June, 1896, *C. Jensen* (these are among the specimens listed by Jensen in Bot. Faer. **1**: 127. 1901).

SCOTLAND: Ben Lawers, 1803, *W. J. Hooker* (listed as *Jungermannia juniperina* β by Hooker in Brit. Jung. *pl. 4.* 1812); Craig Chailleach, *G. E. Hunt;* same locality, June, 1900, *S. M. Macvicar;* Camlochan, July, 1843, *W. Gardiner;* Stuichd-an-Lochain, July, 1842, *W. Gardiner;* near summit of Ben More, July, 1897, *H. N. Dixon* (var. *alpina* Macvicar); Glengyle, June, 1895, *Stirling & Kidston;* Ben Vorlich, July, 1901, *S. M. Macvicar* (listed in Ann. Scottish Nat. Hist. 1902: 114); Ben Udlaidh, June, 1903, *S. M. Macvicar*.

WALES: Snowden Mountain, June, 1915, *A. H. Graves.*

In Ingham's Census Catalogue of British Hepatics, published in 1913, *H. adunca* is quoted from the following provinces: South Wales, North Wales, Lakes, East Highlands, West Highlands, North Highlands and North Isles. It is quoted also from eleven county divisions in Ireland. It is probable that some of these records, especially those from Ireland, are based on *H. Hutchinsiae.*

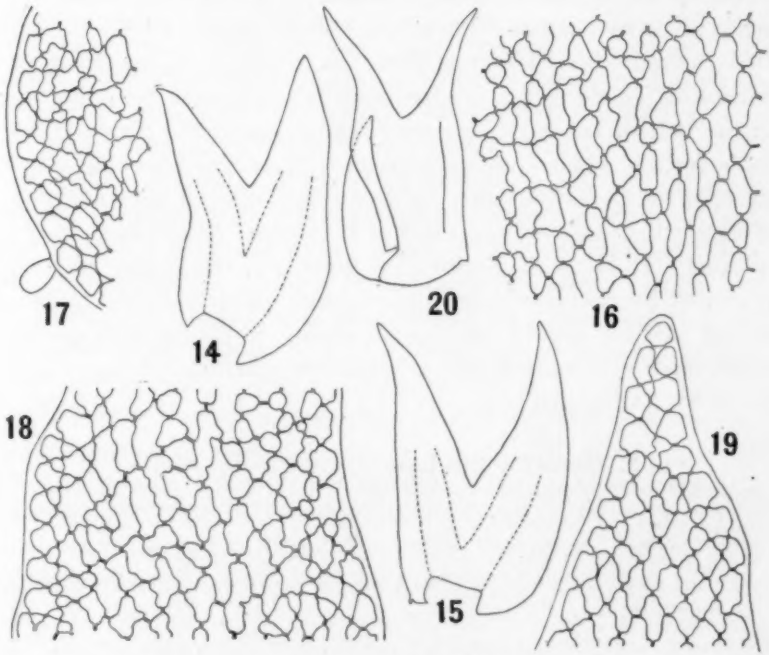
Most of the earlier writers not only failed to distinguish *H. Hutchinsiae* from *H. adunca* but considered the combined species a mere variety or form of the Jamaican *H. juniperina* (Sw.) Trevis. (*Jungermannia juniperina* Sw.). Hooker was apparently the first to advance this idea. In the text accompanying *pl. 4* of his British Jungermanniae he recognized *J. juniperina* as a member of the British flora and included *J. adunca* under the variety "β," to which he did not even give a definite name. "After a most careful examination of Mr. Dickson's *J. adunca*, compared with others of *J. juniperina*, which I have received from Dr. Swartz," he adds in a critical note, "I am unable to find any characters which can induce me to keep them separate." He then calls attention to the larger size of the Jamaican plant and to the greater readiness with which it regains its original appearance when immersed in water but clearly regards these features of but little moment. Weber* protested against Hooker's treatment of *J. adunca* and maintained it as a valid species, in which he was followed by both S. F. Gray and Dumortier. The majority of contemporaneous writers, however, followed the example of Hooker, and the Synopsis Hepaticarum, in 1845, went so far as to cite Scottish specimens under *Sendtnera juniperina* β, without even mentioning *J. adunca* as a synonym. When Gottsche, nearly twenty years later, distinguished between his α *Dicksoniana* and β *Hutchinsiae*, he pointed out in addition the most marked differences between *H. adunca* and *H. juniperina;* and, since this time, both species have been almost universally recognized.

Among the characters of *H. adunca* which Gottsche emphasized was the lack of teeth on the leaves and underleaves. He pointed out the fact that young leaves sometimes showed five to eight primordial papillae at the base, these structures representing the rudiments of teeth, but of actual teeth he found no development. Although this description will apply to the vast majority of leaves, it will not apply to all. An occasional leaf will show one or perhaps two teeth in the basal region. Such a tooth usually consists of a single cell, serving as a stalk for a papilla, but it sometimes attains a length of several cells and becomes more lobe-like in appearance. The occurrence of these teeth, in view of their infrequency and

* Hist. Musc. Hepat. Prodr. 54. 1815.

irregularity, is doubtless more or less abnormal. The same thing may be said of the trifid leaves and of the blunt divisions which occasionally come to light, when a large series of leaves is examined.

Although Dickson's original figures show perianths and mature capsules, these organs seem to be very rarely produced.



FIGS. 14–20. HERBERTA ADUNCA (Dicks.) S. F. Gray

14, 15. Leaves, × 40. 16. Cells from the basal portion of a leaf, showing the basal vitta on the right, × 225. 17. Dorsal base of a leaf, × 225. 18. Cells from the upper part of a dorsal leaf-division, × 225. 19. Cells from the apex of the same division, × 225. 20. Perigonial bract, × 40. FIGS. 14, 16–19 were drawn from Norwegian specimens collected by E. Jörgensen and distributed in Schiffner's Hep. Europ. Exsic. *464*; FIGS. 15, 20, from Norwegian specimens collected by B. Kaalaas and distributed in the same exsiccatae *465*.

Hooker stated definitely that the only fruiting plants he had seen were Scotch specimens furnished by Dickson. Pearson* did not know fruiting plants at all; his description and figures of the bracts and perianths were drawn from Cuban specimens referred to *H. juniperina*, his idea being that the reproductive parts in this

* Hep. British Isles 100, 101. *pl.* 36, *f.* 11, 12. 1900.

species would not differ appreciably from those of *H. adunca*. Perianths were likewise unknown to Stephani, although he quotes from Kaalaas a brief description of bracts, perianths and capsule. Whether Kaalaas actually saw these structures in *H. adunca* is, however, doubtful. The description quoted by Stephani was taken (with certain arbitrary changes) from the account of the *genus* given by Kaalaas,* the account of the species merely stating that the reproductive organs were "ut in genere." According to Macvicar female plants are frequent, but perianths are unknown in the British Isles. He quotes Hooker's statement about Dickson's fruiting plants but suggests that there was probably some mistake on Dickson's part. If this idea could be substantiated there would be no evidence left that *H. adunca* had ever been found in fruit. It is to be hoped that further explorations may be rewarded by the discovery of the missing parts, although a persistent sterility would not be surprising in the present genus, where other well-marked species apparently produce neither archegonia nor antheridia.

2. **Herberta Sendtneri** (Nees) comb. nov.

Schisma Sendtneri Nees, Naturg. europ. Leberm. **3**: 575. 1838.

Jungermannia Sauteriana Hüben. & Genth, Deutschl. Leberm. *108*. 1839 (*nomen nudum*); G. L. & N. Syn. Hep. 240. 1845 (as synonym).

Sendtnera Sauteriana Nees; G. L. & N. Syn. Hep. 240. 1845.

Schisma stramineum Dumort. Bull. Soc. Bot. Belgique **13**: 123. 1874 (in part). Not 1831.

Herberta straminea Trevis. Mem. R. Ist. Lomb. III. **4**: 396. 1877 (in part).

Brownish green, not glossy, growing in more or less extended mats: secondary stems erect or ascending, sparingly and irregularly branched, rigid, mostly 5–8 cm. long, about 0.35 mm. (or fifteen cells) wide and 0.3 mm. (or twelve cells) thick, the cells everywhere with strongly thickened walls: leaves imbricated, more or less secund, broadly ovate, mostly 1.2–1.6 mm. long and 0.75–1.1 mm. wide, bifid one half or a little more, the divisions (in explanate leaves), slightly or not at all curved, acute to acuminate, mostly 0.6–0.9 mm. long and 0.4–0.55 mm. wide, margin irregu-

* Nyt Mag. f. Naturv. **33**: 223. 1893.

larly toothed near the base, the teeth mostly two to five on each side, sometimes small, sometimes larger and lobe-like; vitta indistinct even in the basal region, extending into the divisions but soon coming to an end, undivided portion about 0.25 mm. long and 0.35 mm. wide; cells of vitta mostly 40–70 × 18 μ in the basal portion and 30–40 × 16 μ in the divisions, marginal cells in the basal portion about 14 μ in diameter, cells between margin and vitta about 16 μ in diameter; thickenings distinct in the vertical walls, mostly 4–6 μ wide; cuticle distinctly striolate-verruculose, especially near the base: underleaves similar to the leaves but shorter and more symmetrical: inflorescence unknown.

The following specimens have been examined:

AUSTRIA (TIROL): Kleiner Rettenstein near Jochberg, *A. Sauter* (distributed as *Sendtnera Sauteriana* in Rabenhorst's Hep. Europ. *33a*); near Kitzbühel, August, 1882, *J. Breidler*; Rosskogl, *F. Arnold* (distributed as *Sendtnera Sauteriana* in Gottsche & Rabenhorst's Hep. Europ. *422*); Sellraintal, August, 1912, *H. von Handel-Mazzetti* (distributed as *H. straminea* in Schiffner's Hep. Europ. Exsic. *468*).

Müller and other writers cite the species from Bavaria and Salzburg, as well as from Tirol.

The present species bears a strong resemblance to the true *H. adunca* and it is not at all surprising that botanists have sometimes had difficulty in distinguishing them. Both normally grow in broad mats, their color is much the same except for the fact that *H. Sendtneri* seems never to be tinged with red or purple, their leaves are equally imbricated and divided to about the same extent, their divisions are less curved than in most species of the genus, and the vitta is poorly defined in both, the branches coming to an end far below the apices of the leaves. At the same time they exhibit excellent differential characters. The leaves in *H. Sendtneri* are relatively broader than in *H. adunca*, the same thing is true of the leaf-divisions, and the thickenings in the leaf cells are less conspicuous, those in the vertical walls being only about half as wide. The most striking differences between the two species, however, are to be found in the basal teeth. In *H. adunca*, as already noted, basal teeth are either absent altogether or else occur as a rare abnormality. In *H. Sendtneri* they form a conspicuous feature of the species. It is true that they

may not be present on every individual leaf. Nevertheless, if a series of leaves is examined, the majority will show the basal teeth clearly. Some of the teeth consist of single cells, but most of them are three to ten cells long and often two to four cells wide at the base. Occasionally an even larger, lobe-like tooth is present. Although the basal teeth are almost always marginal it is sometimes possible to demonstrate a surface tooth.

3. **Herberta Hutchinsiae** (Gottsche) sp. nov.

Jungermannia juniperina β Hook. Brit. Jung. *pl. 4.* 1812 (in part).

Sendtnera adunca β *Hutchinsiae* Gottsche; Rabenhorst, Hep. Eur. *210* (accompanying text). 1862.

Herberta adunca β *Hutchinsiae* Schiffn. Lotos **60**: 54. 1912.

Yellowish or brownish green, sometimes tinged with red or purple, often somewhat glossy, growing in more or less extensive mats or in pendent tufts, sometimes mixed with other bryophytes: secondary stems erect, ascending or pendulous, rigid, mostly 5–10 cm. long but sometimes shorter, about 0.25 mm. (or fourteen cells) wide and 0.2 mm. (or twelve cells) thick, the cells everywhere with thickened walls, although showing a fairly marked difference between cortical and median regions: leaves imbricated, strongly secund, unsymmetrical, narrowly ovate, mostly 1.2–1.5 mm. long and 0.45–0.5 mm. wide, the divisions strongly curved and more or less divergent, acuminate to long-acuminate, mostly 0.8–1.2 mm. long and 0.2–0.25 mm. wide; margin normally entire; vitta distinct, extending far out into the divisions but hardly to the apices, undivided portion mostly 0.15–0.18 mm. long and 0.25–0.3 mm. wide; cells of vitta mostly 30–75 × 14–18 μ in the basal portion and 25–50 × 18–20 μ in the divisions, marginal cells in the basal region mostly 16–20 μ in diameter, cells between margin and vitta mostly 18–24 μ in diameter; thickenings distinct, in the vertical walls about 6 μ wide; cuticle faintly but distinctly striolate-verruculose: underleaves similar to the leaves but symmetrical, squarrose, and with straight divisions: male inflorescences normally borne in an interrupted series in the upper part of a stem, more rarely on a lateral or ventral branch; bracts and bracteoles mostly in four to six series, similar to the leaves but with straighter and less divergent divisions and a broad basal pocket, about 1 mm. long and 0.45 mm. wide, margin subentire to sparingly and irregularly denticulate; antheridia mostly two or three in each axil: female inflorescence apparently always terminal on a stem, often with

one or more subfloral innovations; bracts and bracteoles similar, in about three series, those of the innermost series mostly 2.5–3.5 mm. long and 0.7–0.9 mm. wide, suberect and appressed to the perianth, bifid a little more than one half with slender, acuminate, subparallel divisions, margin copiously and shortly denticulate or dentate to or just above the level of the sinus, otherwise entire; bracts and bracteole of the other series a little shorter and often squarrose, the divisions usually more or less divergent, the margin varying from denticulate to coarsely and irregularly dentate; paraphyllia occasionally present, small and irregular; perianth ovate, not contracted at the mouth, about 3.5 mm. long and 0.8 mm. wide, divided for about half the length into six lanceolate, long-acuminate divisions, papillae numerous along the margins of the divisions near the base and on the inner surface of the perianth, usually sessile but sometimes borne on very short stalks: capsule brown, oval, about 1 mm. in diameter, splitting usually into six to eight valves; spores brown, about 25 μ in diameter, minutely echinulate; elaters brown, usually with two loose spirals, rarely with three, about 10 μ wide. [PLATE 8.]

The following specimens have been examined:

NORWAY: Lyse near Stavanger, July, 1897, *E. Jörgensen* (distributed as *H. adunca* β *Hutchinsiae* in Schiffner's Hep. Eur. Exsic. *466;* specimens from the same locality listed by Kaalaas, as *H. adunca*, in Nyt. Mag. f. Naturv. **40**: 247. 1902).

SCOTLAND: Moidart, Inverness, 1898, 1899 and 1901, *S. M. Macvicar* (listed as *H. adunca* in Jour. Bot. **37**: [3]. 1899; specimens from same region distributed as *H. adunca* β *Hutchinsiae* in Schiffner's Hep. Europ. Exsic. *467*); without definite locality or date, specimen from Hooker herbarium; Ben Vorlich, July, 1901, *S. M. Macvicar;* Ben Lavigh, July, 1901, *R. H. Meldrum.*

ENGLAND: Borrowdale, Cumberland, July, 1844, *Mr. Brown;* April, 1893, *W. H. Pearson.*

WALES: Craig-y-can, Merioneth, May, 1877, *C. J. Wild & W. H. Pearson* (distributed as *H. adunca* in Carrington & Pearson's Hep. Brit. Exsic. *42*).

IRELAND: Bantry, *Miss Hutchins;* Killarney, *B. Carrington* (distributed as *Sendtnera adunca* β *Hutchinsiae* in Rabenhorst's Hep. Europ. *210*); Brandon Mountain, *D. Moore* (distributed as "*Sendtnera juniperina* Nees = *Sendtnera adunca* Dickson" in Gottsche & Rabenhorst's Hep. Europ. *491*); same locality, no date, *W. Mitten*, several specimens; same locality, 1881, *D. Mc-*

Ardle; Mangerton Mountain, no date, *W. Mitten;* Mt. Cromaglown, *R. Spruce;* without definite locality or date, specimen from the Hooker herbarium.

ALASKA: Sitka, collector and date unknown (specimen received from Lindberg, in the Austin herbarium); Yes Bay, August, 1895, *T. Howell 1810* (listed as *H. adunca* by the writer in Proc. Wash. Acad. Sci. **2**: 309. 1900); Hot Spring, Baranof Island, June, 1899, *W. Trelease 1525a, 1808* (Harriman Expedition, listed as *H. adunca* by the writer, *l.c.*); Metlakatla, May, 1913, *R. B. Wylie 76, 97; T. C. Frye 109* in part; Ratz Harbor, June, 1913, *T. C. Frye 309;* Saltery Cove, June, 1913, *T. C. Frye 320;* Nichols Bay, June, 1913, *T. C. Frye 384;* Morse Cove, June, 1913, *T. C. Frye 446;* Brownson Bay, June, 1913, *T. C. Frye 470; A. S. Foster 517;* Augustine Bay, July, 1913, *T. C. Frye 561; A. S. Foster 677;* Port San Antonio, July, 1913, *T. C. Frye 605, 649;* Aats Bay, July, 1913, *T. C. Frye 925*. The specimens of Frye, Foster, and Wylie were collected under the auspices of the Kelp Investigation Expedition of the United States Bureau of Soils. They have already been listed by the writer, as *H. adunca*, in Bull. Torrey Club **41**: 601. 1915.

BRITISH COLUMBIA: Fraser Reach, Princess Royal Island, June, 1899, *F. V. Coville & T. H. Kearney* (Harriman Expedition, probably the basis for Osgood's record of *H. adunca* in U. S. Dept. Agric. Biol. Surv. Bull. 21: 14. 1901); Port Renfrew, August, 1902, *S. A. Skinner* (listed as *H. adunca* by the writer in Postelsia 1906: 228); Ucluelet, 1909, *J. Macoun 2* (specimens from same locality distributed as *H. adunca* by Miss Haynes in Amer. Hepat. *72* and by Macoun in Can. Liverworts *83*); Swanson Bay, May, 1913, *T. C. Frye 1174* (Kelp Expedition).

The specimens collected by Miss Hutchins at Bantry, Ireland, and now preserved in the Mitten herbarium at the New York Botanical Garden, should be considered the type of the species.

The following records for *H. adunca* from Alaska should also be noted: without definite locality, date or collector's name (listed by Underwood in Zoe **1**: 366. 1891); St. Paul Island, Pribolof Islands, *C. H. Merriam* (listed by Merriam in Proc. Biol. Soc. Washington **7**: 150. 1892). Underwood's record was probably based on Lindberg's specimens cited above. Merriam's record,

however, was based on specimens in the United States National Herbarium, which, in the writer's opinion, represent a slender form of *Anthelia julacea* (L.) Dumort. This species is now known from several localities in Alaska, and additional specimens, essentially like those of Merriam, were collected on St. Paul Island, in 1897, by T. C. Kincaid (*49*).

The narrower and more deeply divided leaves of *H. Hutchinsiae*, with their more slender and strongly curved divisions will usually distinguish the species from *H. adunca* at a glance. In doubtful cases the distinct vitta extending far out into the divisions will decide the determination. The more gradual tapering of the divisions is clearly brought out by counting their width in cells. In *H. Hutchinsiae*, if the counts are made at a distance of 0.2 mm. from the apices, the divisions are found to have a width of from two to four cells; in *H. adunca* the corresponding counts will usually give from five to eight cells. Counts at the bases of the divisions are much less conclusive, on account of the fact that the divisions in *H. Hutchinsiae* are relatively longer, the bases thereby being often as wide as in *H. adunca*.

Among the specimens listed above, those from Norway are somewhat aberrant. Although some of the shoots conform closely to the type, others bear leaves which are considerably larger. One of the largest leaves measured had a length of 2.4 mm. and a width of 0.95 mm.; another, a length of 2 mm. and a width of 1 mm. The dorsal divisions of these measured, respectively, 1.2×0.45 mm. and 1.05×0.4 mm. Since these leaves are relatively broader than is usual, it might appear at first sight as if the large-leaved shoots approached *H. adunca*, but the distinct vittae present would seem to preclude this idea. In all probability they represent shoots developed under unusual conditions, perhaps exceptionally favorable from a nutritive standpoint; the large leaves might then be regarded as abnormal.

The androecia in *H. Hutchinsiae* are not absolutely constant in position. In normal cases they are borne on the secondary stems just as in *H. adunca*. Under these circumstances an androecium usually proliferates at the apex and then produces a new androecium after a short series of vegetative leaves. In several instances, however, androecia on ventral or lateral branches have been

observed. These are apparently never produced unless the growth of the main male axis is brought to an end in some way, possibly through the failure of an androecium to proliferate, possibly through an accident of some sort. In either case a branch tends to take the place of the main axis and to assume its functions, precisely as a ventral branch of a sterile axis or a subfloral innovation would do. When, therefore, an androecium is borne on a branch of this character, its position can not be regarded as typical.

These considerations gain in significance when *H. Hutchinsiae* is compared with *H. dicrana* (Tayl.) Trevis., a closely related species of the Himalayas. The writer's knowledge of this species is largely based on specimens received from Levier and collected by Decoly and Schaul (*782*) near Kurseong in Sikkim-Himalaya, in May, 1899. These specimens contain both male and female plants and are of especial interest because they served as the basis for Schiffner's statements regarding the androecia of *H. dicrana*.* He notes their occurrence on the ends of branches, their small size, the small number of bracts (about four pairs) which they bear, and the fact that they are sterile at the apices. The branches which bear the androecia are ventral and vary greatly in length. Sometimes the development of the antheridia brings the growth of the branch to an end, but a sterile proliferation of the androecium often occurs. The formation of the male branches seems to be a perfectly normal process and is not preceded by a cessation of growth of the main stem as in *H. Hutchinsiae*. It follows, therefore, that what occurs abnormally in the northern species has become normal in the Himalayan species. It should be noted, however, that ventral androecia are not absolutely constant even in *H. dicrana*. One example was observed where the androecium was borne on a main stem; it had somewhat larger bracts and bracteoles than the ventral androecia but resembled them in other respects. Aside from the difference in the position of the androecia, *H. dicrana* resembles *H. Hutchinsiae* very closely. The leaves and underleaves, the bracts and bracteoles, and the perianths are much the same in the two species, although the divisions of the leaves in *H. dicrana* usually are less strongly curved. The latter species, moreover, is slightly larger, the leaves are less crowded and the thickening of the cell-walls is less pronounced.

* Hedwigia **50**: 148. 1910.

4. **Herberta tenuis** sp. nov.

Schisma juniperinum Sulliv. Musc. Alleg. *258*. 1846. Not Dumort.

Sendtnera juniperina Sulliv.; A. Gray, Man. 689. 1848. Not Nees.

Herberta adunca Underw. Bot. Gaz. **14**: 195. 1889. Not S. F. Gray.

Yellowish or brownish green, rarely tinged with red, growing in more or less extensive mats: secondary stems erect or ascending, sparingly and irregularly branched, rigid, mostly 2–4 cm. long, about 0.15 mm. (or ten cells) wide and 0.13 mm. (or nine cells) thick, outer layer of cells with strongly thickened walls, interior cells with slightly thickened walls: leaves scattered to loosely imbricated, subsquarrose to slightly secund, a little unsymmetrical, subovate, mostly 0.9–1 mm. long and 0.3–0.35 mm. wide, bifid two thirds to three fourths, divisions (in explanate leaves), divergent, slightly or not at all curved, long-acuminate, mostly 0.6–0.7 mm. long and 0.15–0.18 mm. wide, margin entire or with an occasional basal tooth; vitta distinct, extending far out into the divisions but not to the apices, undivided portion about 0.1 mm. long and 1.5 mm. wide; cells of vitta mostly 20–55 × 14 μ in the basal portion and 20–35 × 14 μ in the divisions, marginal cells in the basal region about 14 μ in diameter, in the divisions about 17 μ, cells between margin and vitta about 20 μ; thickenings distinct but not so strongly developed as in most species, in the vertical walls mostly 3–4 μ wide; cuticle minutely striolate-verruculose: underleaves similar to the leaves but symmetrical; inflorescence unknown. [TEXT FIGS. 21–29.]

The following specimens have been examined:

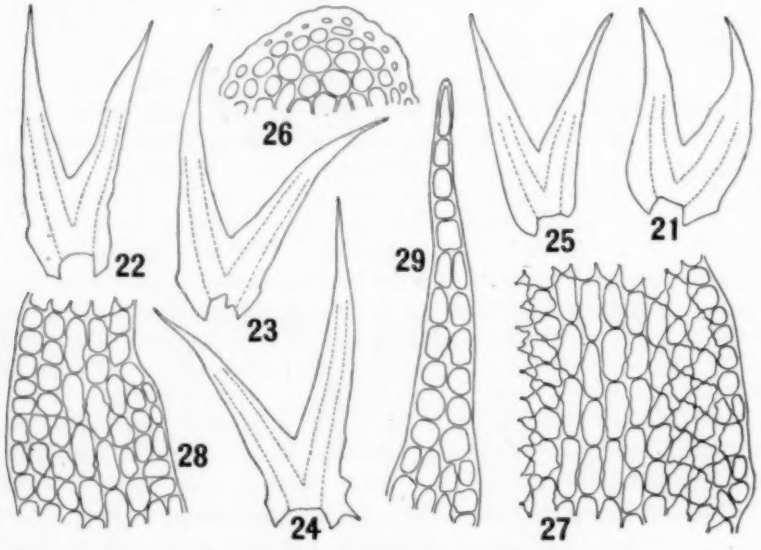
NEW YORK: Kaaterskill Falls, Catskill Mountains, *C. H. Peck* (listed by Peck, as *Sendtnera juniperina*, in Rep. New York State Mus. Nat. Hist. **19**: 70. 1866; both "Cauterskill" Falls and High Peak, Catskill Mountains, are mentioned here); Austin's Hep. Bor.-Amer. *82*, distributed as *Sendtnera juniperina*, is also *H. tenuis* and may possibly include some of Peck's material, the label reading: "Catskill Mountains, New York, *Peck*, Greenwood Mts., N. J., *Aust.*; also in the Alleghanies southward."

NEW JERSEY: Greenwood Mountains, Passaic County, November, 1866, *C. F. Austin* (listed by Britton, as *H. adunca*, in Cat. Pl. New Jersey 351. 1889); Austin's Hep. Bor.-Amer. *82* (see above) is probably made up largely of material from this locality.

PENNSYLVANIA: Stony Creek, Somerset County, *F. Wolle.*

VIRGINIA: summit of White Top Mountain, Washington County, May, 1892, *A. M. Vail & E. G. Britton 9, 91*, and numerous unnumbered specimens; same locality and date, *J. K. Small 77, 79* (listed by Small & Vail, as *H. adunca*, in Mem. Torrey Club **4**: 193. 1894).

WEST VIRGINIA: Tibbs Run, Monongalia County, September, 1892, *C. F. Millspaugh 1659* (listed by Millspaugh, as *H. adunca*, in Prelim. Cat. Fl. W. Va. 496. 1892); Quarry Run, Monongalia County, 1903, *A. LeR. Andrews.*



FIGS. 21–29. HERBERTA TENUIS Evans

21–25. Leaves, × 40. 26. Transverse section of a mature stem, × 225. 27. Cells from the lower part of a leaf, including the vitta just above the forking. × 225. 28. Cells from the upper part of a dorsal leaf-division, × 225. 29. Cells from the apex of a division, × 225. FIG. 21 was drawn from specimens distributed in Austin's Hep. Bor.-Amer. *82;* the remaining figures, from the type specimen.

NORTH CAROLINA: "in montibus Carolinae," *F. Michaux* (listed by Michaux, as *Jungermannia sertularoides*, in Fl. Bor. Amer. **2**: 278. 1803), the label reading as follows: "Junga sertularoides Rich. Fl. b. Am. a Jung. trichophylla vox aut non distincta! Hb. Hooker"; "in montosis editissimis Carolinarum,"

1843, *A. Gray & W. S. Sullivant* (distributed, as *Schisma juniperinum*, in Sullivant's Musc. Alleg. *258*, and listed by Sullivant, as *Sendtnera juniperina*, in A. Gray, Man. 689. 1848); top of Black Mountain, June, 1850; *L. Lesquereux;* Grandfather Mountain, August, 1891, *J. K. Small 32* (also distributed, as *H. adunca*, in Underwood & Cook's Hep. Amer. *126*); Grandfather Mountain, September, 1901, *G. F. Atkinson 11420, 11501* (listed by Andrews, as *H. adunca*, in Bryologist **17**: 59. 1914); near Shulls Mills, Blue Ridge Mountains, September, 1901, *G. F. Atkinson 12054* (listed by Andrews, *l.c.*).

Dr. Small's specimen from North Carolina, No. 32, may be designated the type.

Two additional records for *H. adunca* from the eastern United States may likewise be noted, namely: Carbon County, Pennsylvania; *E. A. Rau* (listed by Porter in Cat. Bryoph. & Pteridoph. Pennsylvania 9. 1904), and mountains of western North Carolina, 1907, *A. J. Grout* (listed by Grout in Bryologist **12**: 54. 1909). In all probability these records were based on *H. tenuis*.

The present species is closely related to *H. Hutchinsiae* but is considerably smaller. Although at first sight the small size might appear to be due to poor development, the study of a large series of specimens from many localities shows pretty conclusively that this is not the case. The size is of course subject to more or less variation, as in all species of *Herberta*, but the measurements of the leaves given in the description represent a fair average of the more robust plants studied, and are only about two thirds as great as the corresponding measurements in *H. Hutchinsiae*. The difference in size is brought out with especial clearness by counting the width of the basal portion in cells between the vitta and the margin. In *H. Hutchinsiae* such a count would give from five to seven cells; in *H. tenuis* from three to five cells. Aside from the difference in size the slightly curved or straight divisions in *H. tenuis* and the thinner cell-walls will distinguish the species from *H. Hutchinsiae*, where the divisions are normally strongly curved and the thickening of the cell-walls much more distinctly marked.

The basal teeth in *H. tenuis*, although an inconstant feature, deserve a few words of comment. When they occur there may be one or, rarely, two teeth on each side, and the underleaves tend

to produce them more frequently than the side-leaves. The teeth are of fair size, often involving several cells, and may be rounded or sharp. In the latter case they are especially conspicuous (TEXT FIG. 24). It has already been noted that teeth form an important feature of the leaves in *H. Sendtneri*, whereas in *H. adunca* and *H. Hutchinsiae* the margin is normally entire. *H. tenuis* occupies an intermediate position in this respect, the teeth being less frequent than in *H. Sendtneri* but more frequent than in either of the other species.

The present paper is based largely on material in the herbarium of Yale University. This has been supplemented by specimens from the Taylor herbarium at Harvard University and from the herbarium of the New York Botanical Garden. Additional specimens have been received from Professsr A. LeRoy Andrews of Cornell University, from Mr. S. M. Macvicar of Invermoidart, Scotland, and from Mr. C. Jensen of Hvalsö, Denmark. The writer would express his sincere thanks to all who have aided him in his work.

SHEFFIELD SCIENTIFIC SCHOOL,
YALE UNIVERSITY.

Explanation of plate 8

HERBERTA HUTCHINSIAE (Gottsche) Evans

FIGS. 1–3. Leaves, × 40.

FIG. 4. Cells from the lower part of a leaf, showing the basal vitta, × 225.

FIG. 5. Cells from the dorsal base of a leaf, showing two rudimentary teeth, × 225.

FIG. 6. Cells from the upper part of a dorsal leaf-division, × 225.

FIG. 7. Cells from the apex of the same division, × 225.

FIGS. 8, 9. Perigonial bracts, × 40.

FIG. 10. Perichaetial bract from next to the last pair, × 27.

FIG. 11. Perichaetial bract from the innermost pair of the same involucre, × 27.

FIG. 12. Paraphyllium from the same involucre, × 27.

Fig. 13. Perianth, spread out flat, × 27.

FIG. 14. Transverse section of perianth, × 40.

FIG. 1 was drawn from Irish specimens collected by B. Carrington and distributed in Rabenhorst's Hep. Europ. *210*; FIG. 2, from Scottish specimens collected by S. M. Macvicar and distributed in Schiffner's Hep. Europ. Exsic. *467*; the remaining figures, from specimens collected by T. C. Frye at Port Antonio, Alaska, *649*.

INDEX TO AMERICAN BOTANICAL LITERATURE

1911-1917

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

Reviews, and papers that relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card issue should be addressed to the Treasurer of the Torrey Botanical Club.

Andronescu, D. I. The physiology of the pollen of *Zea Mays* with special regard to vitality. 1–36. *pl. 1–4.* Champaign. 1915.

Babcock, E. B., & Lloyd, F. E. "Somatic segregation." Jour. Heredity **8**: 82–89. *f. 11, 12.* 25 Ja 1917.

Backhouse, W. O. Note on the inheritance of "crossability." Jour. Genetics **6**: 91–94. 21 D 1916.

Beardslee, H. C. Notes on a few species of Asheville fungi. Mycologia **9**: 30–33. *pl. 4.* Ja 1917.

Beccari, O. Il genre *Cocos* Linn. e le palme affini. L'Agricoltura Coloniale **10**: 435–471. *pl. 1–4.* 30 S 1916; 489–582. *pl. 5–13.* 30 N 1916; 585–623. *pl. 14, 15.* 31 D 1916.

Blake, S. F. *Statice* in North America. Rhodora **19**: 1–9. *f. 1–3.* 10 Ja 1917.

Blakeslee, A. F. Corn and education. Jour. Heredity **8**: 51–57. *f. 1–3.* 25 Ja 1917.

Boot, D. H. A forest census in Lyon County, Iowa. Proc. Iowa Sci. **23**: 397–410. *pl. 12–15+f. 46, 47.* 1916.

Brooks, C., & Cooley, J. S. Temperature relations of apple-rot fungi. Jour. Agr. Research **8**: 139–164. *pl. 1–3+f. 1–25.* 22 Ja 1917.

Burt, E. A. *Pistillaria* (subg. *Pistillina*) *Thaxteri*, Burt. n. sp. Ann. Missouri Bot. Gard. **3**: 403–406. *f. 1–6.* 12 Ja 1917.

Chamberlain, C. J. Prothallia and sporelings of three New Zealand species of *Lycopodium*. Bot. Gaz. **63**: 51–65. *pl. 2, 3.* 15 Ja 1917.

Chivers, A. H. An epidemic of rust on mint. Mycologia **9**: 41, 42. Ja 1917.

Conard, H. S. The white waterlily of Iowa. Proc. Iowa Acad. Sci. **23**: 621–623. 1916.

Conn, H. J. Soil flora studies—I. Jour. Bact. **2**: 35–45. Ja 1917.

Coons, G. H., & Levin, E. The *Septoria* leaf spot of celery or celery blight. Michigan Agr. Exp. Sta. Rep. 29: 372–378. *f. 2–9.* 1916.

Copeland, E. B. Hawaiian ferns collected by J. F. Rock. Philip. Jour. Sci. **11**: (Bot.) 171–173. Jl 1916.

Five new species are described.

Copeland, E. B. Natural selection and the dispersal of species. Philip. Jour. Sci. **11**: (Bot.) 147–170. Jl 1916.

Davis, A. R. A note on the adaptability of the folin micro-kjeldahl apparatus for plant work. Ann. Missouri Bot. Gard. **3**: 407–412. *pl. 7.* 12 Ja 1916.

Davis, C. A. The uses of peat for fuel and other purposes. U. S. Dept. Int. Mines Bur. Bull. 16: 1–214. *pl. 1+f. 1.* 1911.

Detwiler, S. B. The willows. Identification and characteristics. Am. Forest **23**: 3–10. Ja 1917. [Illust.]

Dodge, B. O., & Adams, J. F. Notes relating to the *Gymnosporangia* on *Myrica* and *Comptonia*. Mycologia **9**: 23–29. *pl. 2, 3+f. 1.* Ja 1917.

Douin, C. Les variations du gamétophyte chez les Céphaloziellacées. Rev. Gén. Bot. **28**: 251–256. 15 Au 1916; 257–288. *pl. 11–15.* 15 S 1916; 300–320. *pl. 16–19.* 15 O 1916; 329–352. 15 N 1916.

Duggar, B. M., & Davis, A. R. Studies in the physiology of the fungi. I. Nitrogen fixation. Ann. Missouri Bot. Garden **3**: 413–437 12 Ja 1916.

Durrell, L. W. Notes on some North American conifers based on leaf characters. Proc. Iowa Acad. Sci. **23**: 519–582. *pl. 39–68.* 1916.

Erwin, A. T. Late potato blight epidemics in Iowa as correlated with climatic conditions. Proc. Iowa Acad. Sci. **23**: 583–592. *f. 49–53.* 1916.

Farwell, O. A. Contributions to the botany of Michigan—No. 14. Ann. Rep. Michigan Acad. Sci. 17: 167–182. 1915.

Includes *Ranunculus michiganensis* sp. nov.

Farwell, O. A. Fern notes. Ann. Rep. Michigan Acad. Sci. **18**: 78–94. *f. 13.* D 1916.

Fawcett, G. L. A Porto Rican disease of bananas. Porto Rico Agr. Exp. Sta. Rep. **1915**: 36–41. *pl. 3.* 23 N 1916.

Fernald, M. L. The genus *Elatine* in eastern North America. Rhodora **19**: 10–15. 10 Ja 1917.

Fernald, M. L. A new *Juncus* from Cape Cod. Rhodora **19**: 17–20. 10 Ja 1917.

Juncus pervetus sp. nov.

Fromme, F. D., & Thomas, H. E. The root-rot disease of the apple in Virginia. Science II. **45**: 93. 26 Ja 1917.

Fruwirth, C. Selection in pure lines. Jour. Heredity **8**: 90–94. *f. 13.* 25 Ja 1917.

Gates, R. R. A new evening primrose *Oenothera Novae-Scotiae.* Trans. Nova Scotian Inst. Sci. **14**: 141–145. *f. 1, 2.* 24 N 1916.

Georgeson, C. C. Report of the Alaska Agricultural Experiment Station **1915**: 1–100. *pl. 1–18.* 24 N 1916.

Includes a chapter on plant diseases.

Goodspeed, T. H., & Clausen, R. E. Mendelian factor differences versus reaction system contrasts in heredity. I. Am. Nat. **51**: 31–46. Ja 1917; II. Am. Nat. **51**: 92–101. F 1917.

Graff, P. W. Fungi and lichens from the Island of Guam. Mycologia **9**: 4–22. Ja 1917.

Hartley, C., & Pierce, R. G. The control of damping-off of coniferous seedlings. U. S. Dept. Agr. Bull. 453: 1–32. *pl. 1, 2.* 20 Ja 1917.

Hendrickson, A. H. The common honey bee as an agent in prune pollination. California Agr. Exp. Sta. Bull. 274: 127–132. *f. 1, 2.* D 1916.

House, H. D. Report of the state botanists, 1915. N. Y. State Mus. Bull. 188: 1–117. *pl. 1–4+f. 1–5.* 1 Au 1916.

Includes new species in *Cercospera, Cucurbitaria, Diaporthe, Gloeosporium, Metasphaeria, Microdiplodia, Phoma, Phyllosticta, Ramularia, Scolescosporium, Septoria, Sphaeropsis* and *Stagonospora.*

Howe, M. A. Some economic uses and possibilities of the seaweeds. Jour. N. Y. Bot. Gard. **18**: 1–15. *pl. 189, 190.* Ja 1917.

Reprinted slightly abridged and without illustrations under title "Seaweeds: some of their economic uses and possibilities" in Sci. Am. Suppl. 83: 134, 135. 3 Mr 1917.

Hubbard, F. T. A new *Agropyron* from Cape Breton. Rhodora **19**: 15–17. 10 Ja 1917.

Agropyron acadiense sp. nov.

Hutcheson, T. B., & Quantz, K. E. The effect of greenhouse temperatures on the growth of small grains. Jour. Am. Soc. Agron. **9**: 17–21. *pl. 1, 2+f. 1.* Ja 1917.

Kenoyer, L. A. Insect pollination of *Frasera stenosepala*. Proc. Iowa Acad. Sci. **23**: 487, 488. 1916.

Kenoyer, L. A. Insect pollination of timberline flowers in Colorado. Proc. Iowa Acad. Sci. **23**: 483–486. 1916.

Kidder, N. T. A form of *Solidago sempervirens* with white rays. Rhodora **19**: 20. 10 Ja 1917.

Korstian, C. F. Evaporation and soil moisture in relation to plant succession. Proc. Soc. Am. Foresters **11**: 430–433. O 1916.

Krall, J. A. The formalin treatment for controlling oat smut. Proc. Iowa Acad. Sci. **23**: 593–620. 1916.

Larsen, L. T., & Woodbury, T. D. Sugar pine. U. S. Dept. Agr. Bull. 426: 1–40. *pl. 1–10.* 30 D 1916.

Pinus lambertiana.

Lloyd, C. G. Mycological notes. 43: 589–604. *f. 830–854+portrait.* S 1916.

Includes notes on *Cordyceps* and *Lysurus* and on rare fungi received from correspondents.

Lloyd, C. G. Mycological notes 44: 605–620. *f. 855–881+portrait.* D 1916.

Includes notes on *Cordyceps, Trametes, Favolus, Dacryomyces, Exidia, Stereum, Polystictus, Peziza, Lycoperdon, Catastoma,* and Lewis David von Schweinitz.

Loeb, J. Influence of the leaf upon root formation and geotropic curvature in the stem of *Bryophyllum calycinum* and the possibility of a hormone theory of these processes. Bot. Gaz. **63**: 25–50. *f. 1–30.* 15 Ja 1917.

Long, W. H. A preliminary report on the occurrence of western red-rot in *Pinus ponderosa*. U. S. Dept. Agr. Bull. 490: 1–8. 18 Ja 1917.

MacCaughey, V. *Gunnera petaloidea* Gaud., a remarkable plant of the Hawaiian Islands. Am. Jour. Bot. **4**: 33–39. 3 F 1917.

Marsh, C. D., & Clawson, A. B. Lupines as poisonous plants. U. S. Dept. Agr. Bull. 405: 1–44. *pl. 1–4.* 5 D 1916.

McClintock, J. A. Peanut mosaic. Science II. **45**: 47, 48. 12 Ja 1917.

McCubbin, W. A. The white pine blister rust; does the fungus winter on the currant? Science II. **45**: 87. 26 Ja 1917.

Merrill, E. D. New plants from Samar. Philip. Jour. Sci. **11**: (Bot.) 175–206. Jl 1916.

Includes descriptions of 32 new species.

Mix, A. J. Sun-scald of fruit trees: a type of winter injury. Cornell Agr. Exp. Sta. Bull. 382: 237–284. *pl. 18, 19+f. 60–61.* O 1916.

Morse, W. J. Studies upon the blackleg disease of the potato, with special reference to the relationship of the causal organisms. Jour. Agr. Research **8**: 79–126. 15 Ja 1917.

Murrill, W. A. New combinations. Mycologia **9**: 40. Ja 1917.

Murrill, W. A. Some fungi collected in Virginia. Mycologia **9**: 34–36. Ja 1917.

Murrill, W. A. Two new species of fleshy fungi. Mycologia **9**: 40, 41. Ja 1917.

Gymnopus Ellisii and *Omphalopsis pallida*, spp. nov.

Newins, H. S. The natural root grafting of conifers. Proc. Soc. Am. Foresters **11**: 394–404. *f. 1–6.* O 1916.

Oakley, R. A., & Garver, S. *Medicago falcata*, a yellow-flowered alfalfa. U. S. Dept. Agr. Bull. 428: 1–70. *pl. 1–4+f. 1–23.* 9 Ja 1917.

Olive, E. W., & Whetzel, H. H. *Endophyllum*-like rusts of Porto Rico. Am. Jour. Bot. **4**: 44–52. *pl. 1–3.* 3 F 1917.

Includes *Botryorhiza Hippocrateae* and *Endophylloides portoricensis* gen. et spp. nov.

Osterhout, W. J. V. Antagonism and permeability. Science II. **45**: 97–103. *f. 1.* 2 F 1917.

Osterhout, W. J. V. Similarity in the effects of potassium cyanide and of ether. Bot. Gaz. **63**: 77–80. *f. 1.* 15 Ja 1917.

Palmer, E. L. A seed key to some common weeds and plants. Proc. Iowa Acad. Sci. **23**: 335–394. *pl. 9–11.* 1916.

Pammel, L. H. Notes on the weeds of California. Proc. Iowa Acad. Sci. **23**: 489–493. 1916.

Pammel, L. H. Some notes on California forest flora. Proc. Iowa Acad. Sci. **23**: 494–518. *pl. 32–38+f. 48.* 1916.

Paul, B. H. The pine blister rust. N. Y. Pub. Cons. Comm. Bull. 15: 1–18. Ja 1917. [Illust.]

Pearl, R. The selection problem. Am. Nat. **51**: 65–91. F 1917.

Peck, M. E. A section of Upper Sonoran flora in northern Oregon. Proc. Iowa Acad. Sci. **23**: 317–334. 1916.

[Popenoe, P.] Odd plant malformations. Jour. Heredity **8**: 63–68. *f. 4–9.* 25 Ja 1917.

Povah, A. H. W. *Helicostylum* and *Cunninghamella*: two genera of the Mucorales new to the state. Ann. Rept. Michigan Acad. Sci. **17**: 152–155. *pl. 16, 17.* 1915.

Reed, G. M. Phytopathological survey of the trees and shrubs of Prospect Park and the Botanic Garden (Brooklyn)—1. Report of the first season's work. Brooklyn Bot. Gard. Record 6: 14–20. Ja 1917.

Robinson, B. L. A monograph of the genus *Brickellia*. Mem. Gray Herb. 1: 1–151. *f. 1–95*. 3 F 1917.
Includes eleven new species and many new sections and new combinations.

Sackett, W. G. A bacterial disease of the Wragg cherry. Jour. Bact. 2: 79, 80. Ja 1917.
Preliminary note.

Salter, R. C. The behavior of legume bacteria in acid and alkaline media. Proc. Iowa Acad. Sci. 23: 309–313. *f. A, B.* 1916.

Sanford, F. H Michigan's shifting sands. Their control and better utilization. Michigan Agr. Exp. Sta. Ann. Rep. 29: 385–413. *f. 1–22*. 1916.

Sears, P. B. Amiotic parthenogenesis in *Taraxacum vulgare* (Lam.) Schrk. and *Taraxacum laevigatum* (Willd.) Dc. Ohio Jour. Sci. 17: 97–100. Ja 1917.

Seaver, F. J. Photographs and descriptions of cup-fungi—V. *Peziza proteana* and *Peziza violacea*. Mycologia 9: 1–3. *pl. 1*. Ja 1917.

Shamel, A. D. Bud variation in lemons. Jour. Heredity 8: 75–81. *f. 10*. 25 Ja 1917.

Shear, C. L., Stevens, N. E., & Tiller, R. J. *Endothia parasitica* and related species. U. S. Dept. Agr. Bull. 380: 1–82. *pl. 1–23+f. 1–5*. 15 Ja 1917.

Shufeldt, R. W. The American milkweeds. Am. Forest. 23: 21–28. *f. 1–21*. Ja 1917.

Shull, C. A. An interesting modification in *Xanthium*. Am. Jour. Bot. 4: 40–43. *f. 1–3*. 3 F 1917.

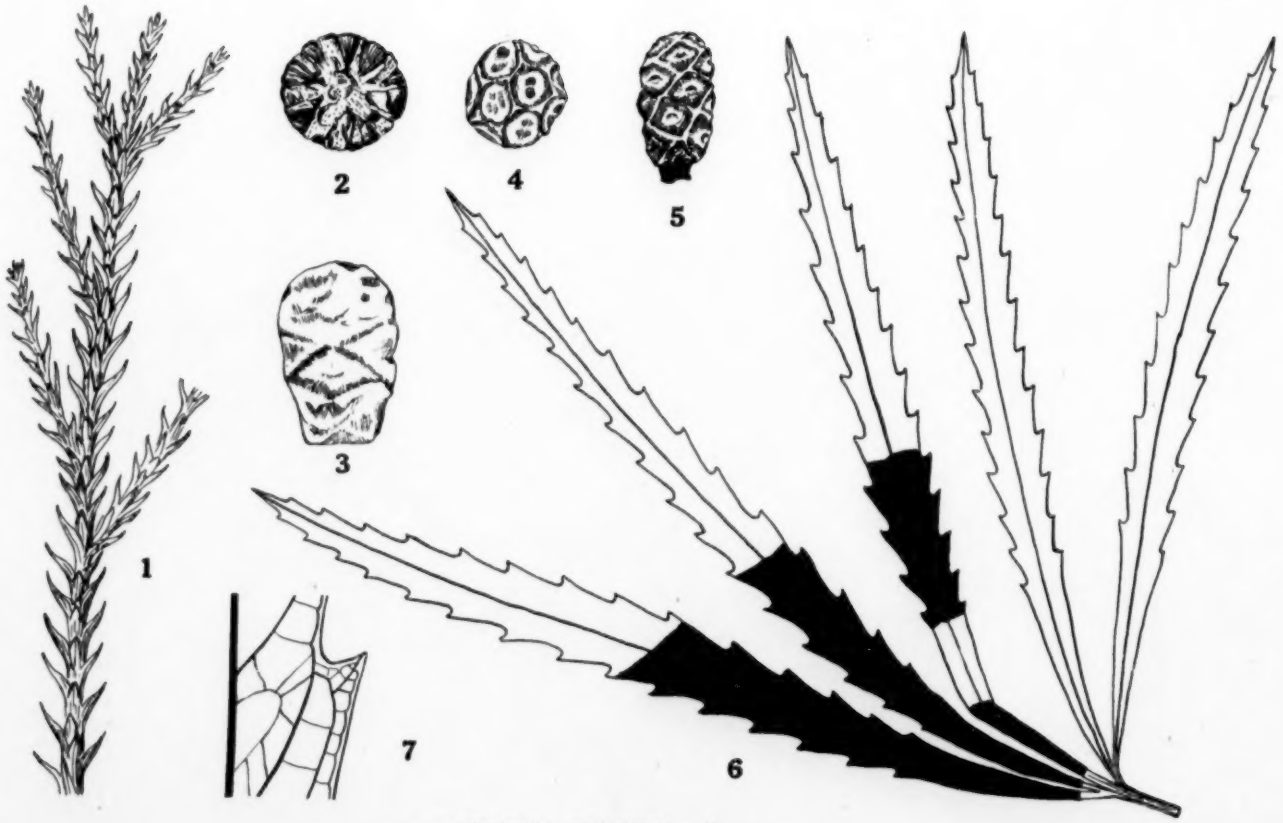
Smith, C. O. Comparative resistance of *Prunus* to crown gall. Am. Nat. 51: 47–60. *f. 1–6*. Ja 1917.

Spaulding, P., & Hartley, C. Safety first in tree planting. Am. Forest. 22: 665–669. N 1916. [Illust.]

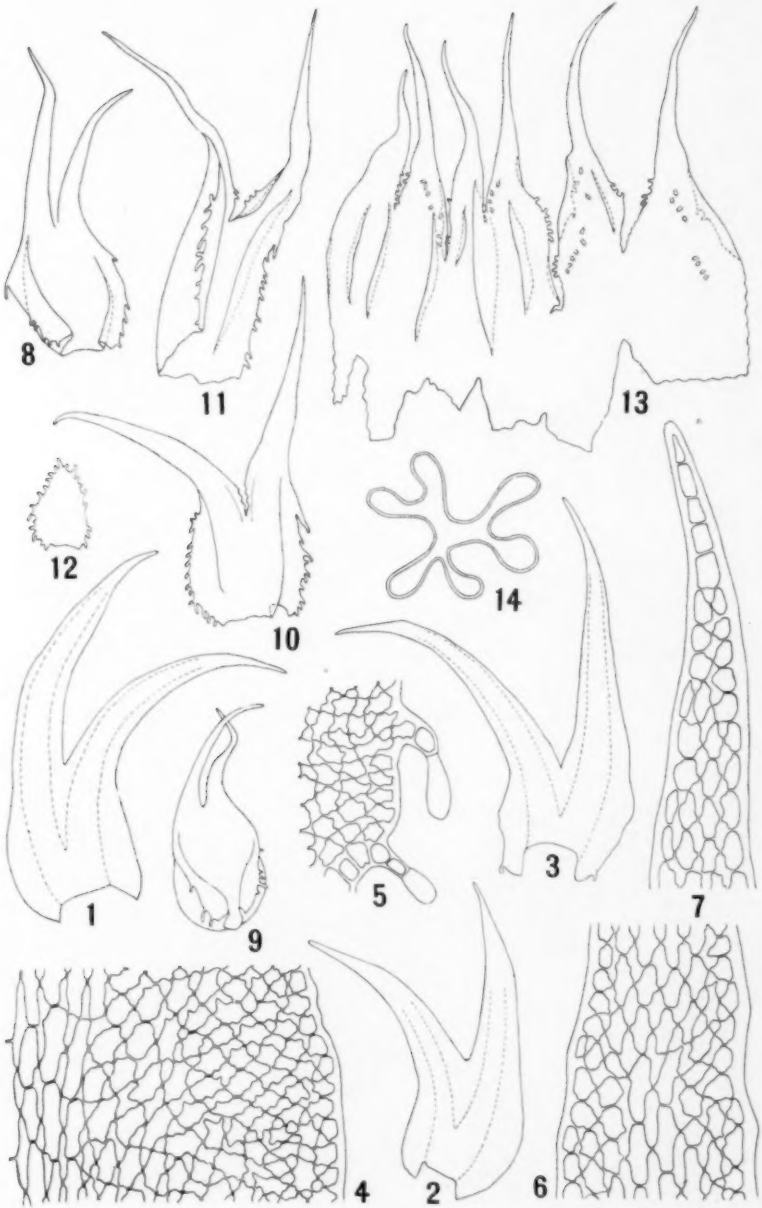
Spessard, E. A. Prothallia of *Lycopodium* in America. Bot. Gaz. 63: 66–76. *f. 1–21*. 15 Ja 1917.

Stevens, N. E. The influence of certain climatic factors on the development of *Endothia parasitica* (Murr.) And. Am. Jour. Bot. 4: 1–32. *f. 1–3*. 3 F 1917.

Thone, F. E. A. Pioneer plants on a new levee—II. Proc. Iowa Acad. Sci. 23: 423–426. 1916.



1–5. SEQUOIA CONCINNA HEER
6, 7. DEWALQUEA INSIGNIFORMIS BERRY



HERBERTA HUTCHINSIAE (GOTTSCHE) EVANS